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LADIES' SLIPPERS.

BY SHIRLEY HIBBERD.

(*With Coloured Plate of Cypripedium Veitchianum.*)

THE ladies' slippers are at once the least interesting of all known orchids with those who cultivate solely with a view to their decorative uses, and the securing of special variations from types; but the most interesting to those who give attention to organic structure, and physiology, and botanical distinctions. While both parties rejoice in their exquisite beauty, the first is oftentimes wearied with their stubborn adherence to settled forms and colours, and the apparent impossibility of altering their forms by hybridization, the philosophic observer finds in them solutions of problems in phytology, and exceptions to the prevailing details of orchid structure that render them perpetually entertaining and attractive. In common with the majority of orchids now in cultivation, they have not long enjoyed the favour of cultivators, for the simple reason that until lately very few were known. One of them, the common ladies' slipper, *C. calceolus*, is a native of Britain, though very rarely to be found growing wild at the present day; and of all the rest it may be said that we have so recently become acquainted with them that very much pertaining to their history has the charm of novelty added to peculiarity of structure. In the *Hortus Kewensis*, of 1810, only six species of Cypripedium are entered as being then cultivated in the Royal Gardens, and they are all (with the exception of *C. calceolus*) hardy North American species, named respectively *parviflorum*, *pubescens*, *spectabile*, *humile*, and *arietinum*. In Sweet's *Hortus Britannicus*, 1830, eleven species are entered, and these again are all hardy English and American kinds, except two—namely, *C. venustum* and *C. insigne*, natives of India, and originally obtained from Nepaul—the first in 1816, the second in 1819. In Don's *Hortus Cantabrigiensis*, 1845,

there are thirteen entered, including *C. purpuratum*, introduced from the Malays in 1837, and the beautiful *C. barbatum*, from Mount Ophir, in 1841. Since that date the number has steadily increased, and within ten years past some very notable additions have been made by the introduction of such noble species as *Veitchianum*, *lævigatum*, *caudatum*, *concolor*, and others. It must not be supposed, however, that all the species and varieties recorded in the books are valued, or even known to cultivators. With the exception of *C. calceolus*, which is known by a few—very few—collectors of scarce and curious plants, the hardy species have no place in our gardens, success in cultivating and keeping them having proved so rare as to discourage the most ardent lovers of herbaceous plants. Now and then some spirited trader secures an importation of these plants, but it invariably ends, not in his finding customers for them, nor yet in growing them for his own amusement; he simply loses them, and there ends the speculation. But the majority of the tropical species are easily grown and multiplied; and as they are very various in character, some of them extremely curious, and all of them beautiful, so we meet with some of them wherever exotic orchids are cultivated, even if only on a small scale. The favourites at present are *C. insignis*, which will thrive in any warm greenhouse; *C. barbatus*, and its varieties; *C. villosum*, *C. Veitchianum*, *C. Stonei*, and *C. caudatum*.

The distinctive character of the Cypripedium must become immediately evident to the most casual observer who has an opportunity of seeing any of the species grouped with examples of other families of orchids. They are terrestrial plants; they neither produce pseudo-bulbs above the soil, nor send out snake-like aerial roots for prehensile or nutritive purposes. Instead of the great branching spike bearing hundreds of flowers, as in some of the Oncidiums; or the compact panicle towering high above our heads, as in some Vandas; or the whip-like, arching stem, bearing many great butterfly-shaped flowers, as in Phalænopsis; or the forest of flowers, making clouds of gold, and amber, and rose, as when the sun sets in glory, which the Dendrobes surprise us with; we have here flowers that are generally rather sober in colouring, and that are in many cases produced singly; or when more than one occurs on a stem, the spike is few-flowered. But as every genus has what may be called its accidental characters, by means of which it is identified without the aid of a botanical analysis, we may allow all this to pass in order to take note of the structural peculiarities of these plants. Comparing them with other orchids, it will be observed that the lip is neither like a frill, nor a banner, nor a tongue, nor a hood; but it is folded so as

to form a pouch, and in some of the species the pouch so nearly resembles a shoe as to justify the popular likening of it to a "lady's slipper." This pouch-like labellum is an essential part of the organic construction, and is directly related to the fertilization of the ovary, as Mr. Darwin* has very clearly shown by his original and painstaking researches. In other words, were the pouch modified or removed, the whole plan of the flower, as respects the disposition of the reproductive organs, would need to be modified also, the mechanical relationships of the several parts being matters of necessity, and every minute detail fitting properly into a complicated scheme.

But let us glance at the construction in order to obtain some distinct idea of the nature of the demarcation which lends so peculiar an interest to the study of the ladies' slippers. The plan of an orchid is *ternary*, and it consists in all of fifteen elementary parts. That we cannot very easily trace these out in any orchid is owing to the fact that some of the parts are commonly confluent, or peculiarly modified, or extravagantly developed, or nearly suppressed. There are three *sepals*, and these are usually determinable, because usually nearly equal; three *petals*, one of which usually gives the flower its most interesting feature, being modified into what is termed the *labellum*, or lip. There are three *stamens*, only one of which is commonly developed, and this is confluent with the pistil forming the *column*. In Cypripedium alone do we find three stamens, and by the aid of this genus, therefore, we obtain a key to one of the life mysteries of this mysterious order. Yet here again ordinary eyesight is baffled, for only two stamens can be found in Cypripedium, and these are placed right and left of the column; the third is in the customary place between them, but being sterile is not recognised until we have made a careful study of the flower. There are three *pistils*, but these again are so modified as to require to be discovered in the mind ere they can be traced in the flower. They are, in the first place, united, and confluent with the stamen; the upper stigma is modified into the extraordinary organ called the *rostellum*, which ordinarily presents no likeness to a stigma at all; and the two lower stigmas are confluent, and appear as one, and this one occupies a central position below the anther, and is *the stigma* to which reference is made in descriptions, and to which special interest attaches in respect of the process of fertilization. Lastly, the ovary consists of three perfect *carpels*, stationed alternately with the stamens opposite the petals, and bearing the placentæ in their axes, and of three other pieces, destitute of placentæ, and eventually

* *The Various Contrivances by which British and Foreign Orchids are Fertilized by Insects.* By Charles Darwin, M.A., F.R.S., etc. Murray, 1862.

separating from them when the fruit is ripe. The frequency of composite organs, and the peculiar individualities of development of certain parts, especially of the petals and the lip, result in that endless variety of form which render the orchids so strangely attractive and fascinating to botanists, florists, and sight-seers, all of whom are not the less charmed by their beautiful colouring and their exquisite odours.

In Cypripedium there are several exceptions to the prevailing type of structure, as will be seen on reference to the plate of *C. Veitchianum*. The topmost piece, which may be likened to a banner, and the striated colouring of which is beautiful beyond all description, that piece is a sepal; where are the other two? They are conjoined, and form one, corresponding in position to the one already likened to a banner. Right and left of the centre are placed two petals, like a pair of wings, and in the centre is the third petal in the form of a pouch or slipper. The elder Darwin saw in this arrangement of parts, and especially in the swollen pouch and eye-like anthers of *C. calceolus*, a resemblance to a spider, and in the figure of the plant in the "Botanic Garden" a very spider-like aspect is given to it—in fact, a *leetle* exaggeration, perhaps, to justify the fancy embodied in the passage in which the flower is celebrated:—

> "So where the humming-bird in Chili's bowers,
> On murmuring pinions robs the pendant flowers;
> Seeks where fine pores their dulcet balm distil,
> And sucks the treasure with proboscis bill;
> Fair CYPRIPEDIA, with successful guile,
> Knits her smooth brow, extinguishes her smile;
> A spider's bloated paunch and jointed arms
> Hide her fine form, and mask her blushing charms;
> In ambush sly the mimic warrior lies.
> And on quick wing the panting plunderer flies."
>
> CANTO IV. 501—510.

That stress should be laid upon the exceptional character of the orchids under consideration will not surprise any who have read the masterly treatise of the living Darwin. He says, "Lindley's last and seventh tribe, including only one genus, Cypripedium, differs from all other orchids far more than any other two do from each other. An enormous amount of extinction must have swept away a multitude of intermediate forms, and left this single genus, now widely disseminated, as a record of a former and more simple state of the great orchidean order." Cypripedium is destitute of a rostellum, all three stigmas being fully developed, but confluent. The anther, which is present and fertile in other orchids, is here rudimentary, sterile, and appears as a shield-like projecting body deeply notched on its lower margin. The two fer-

tile anthers producing pollen grains, which are not united into waxy masses, nor tied together by elastic threads, nor furnished with a caudicle as in other orchids, but are immersed in, and coated by, viscid fluid, which is so glutinous that it can be drawn out into threads. "As the two anthers stand behind and above the lower convex surface of the stigma, it is impossible that the glutinous pollen can get to this, the fertile surface, without mechanical aid. An insect could reach the extremity of the labellum, or the toe of the slipper, through the longitudinal dorsal slit; but according to all analogy, the basal portion in front of the stigma would be the most attractive part. Now, as the flower is closed at one end, owing to the toe of the labellum being upturned, and as the dorsal surface of the stigma, together with the large shield-like rudimentary anther, almost close the basal part of the medial slit, two convenient passages alone are left for an insect to reach with its proboscis the lower part of the labellum—namely, directly over and close outside the two lateral anthers. If an insect were thus to act, and it could hardly act in any other way, it would infallibly get its proboscis smeared with the glutinous pollen, as I found occur with a bristle thus inserted. . . . . Thus an insect would place either the flower's own pollen on to the stigma, or, flying away, would carry the pollen to another flower. . . . . We thus see how important, or rather how necessary, for the fertilization of the plant is the curious slipper-like shape of the labellum in leading insects to insert their probosces by the lateral passages close to the anthers." Glutinous pollen grains, so peculiar to the Cypripediums that they alone possess them, are equally essential to this scheme of fertilization, and thus Mr. Darwin winds up by remarking, that "there is no superfluity in the means employed."

The cultivation of Cypripediums is, generally speaking, a most easy matter. Indeed *C. insigne* is the best of all plants for beginners in orchid culture, as it at once furnishes a key to many of the peculiarities of orchids, and adapts itself to various degrees of good and bad treatment. A shady position in a warm greenhouse, the soil to be a mixture of peat, loam, and silver-sand, and plenty of water in the season of its growth, are the conditions most conducive to its well-being. The stove kinds require only the ordinary treatment of what are called Indian orchids—that is, a temperature varying from a day maximum of 65° in winter to a day maximum of 90° in summer, and a night minimum of 60° in winter to a night minimum of 70° in summer, to be kept moist at all seasons, and when in active growth to have abundance of water. The hardy species are so difficult to grow that even in botanic gardens, and in places where all the resources of art and fortune are at com-

mand for the purpose, it is but seldom any of them are seen at all, or if seen are far from presenting such an appearance of health, and vigour, and beauty, as they are described as presenting when found growing wild. I wish to speak with all possible modesty on this subject; but having something to communicate, I shall endeavour to combine the results of experience with the results of thought in offering a code for the management of these rare plants. The first new light that dawned upon me in connection with this subject came from a collection of hardy orchids, that had been obtained with great care, and were planted out in a border consisting of a mixture of peat, leaf-mould, loam, and nodules of chalk. They had the usual care, and made the usual return, some doing well, but the majority making but a sorry figure. Still the collection was kept up by supplying with new plants the places of those that perished; and in due time I was laid by through a long and severe attack of tic, and as the collection of hardy orchids was looked upon with contempt by all in the place except myself, the bed became a mass of weeds; and though it was scarcely possible to find the places of any of them by their leaves, which were mixed with much rough herbage, their flowers surpassed in strength, and abundance, and beauty, everything of the kind I had ever seen before. I began to reflect upon this, and soon came to the conclusion that as they invariably grow amongst grasses, sedges, patches of Narthecium, etc., etc., in their native wilds, so, when brought into the garden, they should be similarly accompanied. No doubt our customary mode of keeping the beds clean exposes these plants to an undue amount of evaporation, which is exhaustive to them, and deprives them of a share in that condensation of dew which goes on all night long where innumerable living vegetable sprays are associated together, each spray distilling its nutrient drop from the generous atmosphere. I thenceforth sought for suitable plants to "surface" the beds where the orchids were planted, and I never found any to surpass *Festuca ovina*, which rejoices in the same soil as an orchid bed should consist of, and is both elegant, appropriate, and marvellously active in the condensation of dew and its conveyance to the earth by means of its wiry leaves; equally useful for small growing kinds, such as Gymnadenia, Ophrys, Habenaria, etc., etc., is the neat mossy herbage of *Spergula saginoides*, or of *Saxifraga hypnoides*; and to make an end of this part of the disquisition, it may be said that hardy orchids should always be grown in the midst of herbage of some sort, and the best way to accomplish it is to select plants that are suitable in habit, and at the same time worthy to be associated with such beautiful subjects. Shade, moisture, and protection in winter, are points of some impor-

tance, but given the herbage, nearly all the difficulties of orchid-growing come to an end.

Among the hardy species the first, without doubt, is *C. spectabile*, with its huge, finely-formed, rosy-purple lip. Next to this we may place *C. calceolus*, which is still to be met with in certain spots in the county of Durham known to a few, and who happily have sufficient caution to abstain from publication of the names of the localities. *C. acaule*, with the lip split into two equal lobes, is both interesting and pretty.

Among the species requiring to be cultivated in the stove, *C. Schlimii* is at once rare and exquisitely beautiful. It produces spikes of five to eight flowers each, the sepals and petals are white and green, the lip mottled and striped with rose on a white ground; *C. barbatvm*, and its varieties; *C. Veitchianum*, so superbly striped; *C. caudatum*, *C. lævigatum* and *C. Stonei*, are the finest of the "tailed" series; in these the petals are prolonged, so as to present, with the help of a little fancy, a resemblance to mustachios set on each side of a gaping mouth and extravagant chin—a burlesque altogether of humanity. *C. insigne* is beautiful, and as it does not need stove heat, is useful to persons who grow orchids in cool houses. *C. villosum*, *purpuratum*, *Farrieanum*, and *hirsutissimum* are essential in a collection. The last is indeed a remarkable species, producing flowers of great size. *C. concolor* is notable for the beauty of its variegated foliage; the flowers are yellow, with chocolate spots. If we halt here, it is not because the subject is exhausted, but because we cannot afford more space, even for any more of such elementary and superficial particulars as have been hazarded already.

HYPOTHETICAL CONTINENTS.

BY H. M. JENKINS, F.G.S.

The present surface of the globe has admitted of division into several marine and terrestrial regions, each characterized by its inhabitants possessing, as a whole, more or less distinctive features; just as, on the principle of nationalities, we might divide Europe, Asia, and Africa into several natural kingdoms. This division has involved no theoretical considerations of any importance, and it is only when an attempt is made to explain the *origin* of the inhabitants of any particular area that the naturalist ventures to step beyond the region of unyielding facts, and addresses himself to the more pliant province of hypothesis. The palæontologist, also, frequently seeks to trace the origin of ancient faunas and floras, and finds assistance in comparing the population* of bygone periods with that now peopling the earth's surface in the same, or neighbouring, or distant areas. And as, in searching for the origin of things, we must necessarily go back to some previous period, his palæontological knowledge specially fits him for the task, on account of his being acquainted with those facts, the ignorance of which not unfrequently forces the student of recent nature into the wilderness of pure hypothesis, or even imagination.

Two theories are prevalent respecting the origin of organic beings in particular areas. The first of these is that the fauna and flora of each great area possess, as a whole, certain distinguishing characteristics which belong to that district alone, and have never been disseminated through other regions; and that the species composing the population of that area have been *created* from time to time, probably as representative species died out. The opposing theory is that of the derivative origin of every group of organisms, whether species, genus, etc.; in other words, that each species is the modified descendant of some other species of the same genus, until the successive modifications cause so wide a divergence from the type, that a modified form transgresses the conventional circle which we draw round the generic type, and thus causes us to refer it to another genus.

It is quite obvious that if the first theory be true, any attempt to trace the origin of the present and past faunas and floras must necessarily be completely futile; for have we not their origin sufficiently elucidated in the dogma that "they

* The use of the terms "population," "peopling," etc., is in this paper restricted to the animal and vegetable "population," and is not meant to include man.

were created on the spot"? How utterly aimless, then, is palæontology, reduced in this way to a leviathan catalogue of fossils!

It will, therefore, be necessary for me to assume as a postulate the truth of the doctrine of the derivative origin of species; but it is not my intention here to adduce any facts or arguments in its favour, or respecting the causes which have conspired to produce the necessary modification; it is enough for my purpose to mention that compulsory wandering, or "migration," as it is termed, is one of them, and the one that most concerns the subject of this article.

Granting the postulate I have mentioned, the palæontologist can frequently infer—with greater or less probability of its truth, according to the state of our knowledge on the subject—whence came the progenitors of any particular assemblage of animals and plants. In the case of marine organisms he can also indicate, by reference to the position of geological formations of the period, the route by which the ancient ancestors travelled from their own habitation to that of their more recent descendants; in fact, it is chiefly where terrestrial life is concerned that he meets with any serious difficulty, and then generally as to the route.

During the tertiary period, and probably through all geological time, organic life was subject to similar laws of distribution as at present, and as climatal, hydrographic, and other physical conditions changed, a corresponding alteration was produced in the faunas and floras of the regions affected. We may therefore consider that migration and emigration of animals and plants were as constantly taking place as elevations and depressions of the land.

During their wanderings the specific features of organisms became more or less changed; weak and tender species dying off or becoming modified, new forms thus coming in, and varieties of old ones being formed, and the representatives of the various faunas becoming entombed at their death in the localities where they had severally existed. Now the palæontologist has to contemplate the results of these changes and migrations; he has to "try back," and decipher step by step the order of proceeding, and to write a history of the life of each period—not a mere catalogue of names and list of peculiarities, like the foreign consular passports, but an intelligent record of the wanderings and fortunes, ancestors and descendants, of the different faunas, and even species, with which he has to deal.

As a few out of many known examples of the evidence of changes which palæontology has revealed to us, I may cite the correspondence in facies between the recent American flora

and the plants of American eocene deposits and of European (notably Swiss) miocene; between the shells of the Faluns and those which are now found in eastern seas; between the eocene mammals of Europe and the existing tapirs of South America; and, finally, between the eocene plants of Europe and the existing flora of Australia. Many other examples might be given, but we have selected these as specially bearing on the subject of this article. There are also instances of "isolated faunas," such as those of Australia and Madagascar, which present some very curious differences from the animal population of the nearest continents.

Now "hypothetical continents," the term I have chosen as the title of this article, have been invoked to account for both classes of phenomena, and in the following pages I shall endeavour to investigate the probability of their furnishing the true explanation of the facts in each case.

Of these "hypothetical continents," the most celebrated is the Atlantis, partly on account of its having been the first proposed to explain a natural history difficulty, and partly on account of its name and position giving it an appearance of truth, by resolving an ancient legend into a scientific fact. This great continent, or "sunken island," was used by Professor Unger to account for the similarity of the miocene flora of Europe to the recent flora of America; it has formed the subject of several essays by distinguished botanists and geologists, and has been popularly illustrated on more than one occasion;* its prominent features are therefore tolerably well-known.

A less known theory of Professor Unger's is that of a complete land-connection between Europe and Australia during the eocene period, an idea suggested by the affinity of the majority of European eocene plants to those now living in Australia, the remainder belonging to genera now exclusively Asiatic.†

A third theory is Dr. Sclater's hypothetical continent, "Lemuria," stretching from Hindostan through Madagascar to the West Indies.‡ Dr. Sclater believes that this continent must have existed on account of the affinity of some of the curious mammals of Madagascar to some now living in India, and to others existing in the West Indies; and on account of the entire distinctness of the Madagascarian from the South-African mammalian fauna.

Now these theories depend upon the principle that the

* See especially *Journal of Botany*, No. 25, January, 1865, p. 12; Lyell's *Elements*, sixth edition, p. 265; and *Natural History Review*, 1862, p. 149.

† *New Holland in Europa*, and *Journal of Botany*, No. 26, February, 1865.

‡ *Quarterly Journal of Science*, vol. i. No. 2, p. 213, 1864.

affinity of certain animals, or of certain plants, implies their common origin, and in the case of terrestrial organisms, an almost if not a quite continuous land-connection between the habitats of the allied organisms. This principle is perfectly sound, according to my notions, and of infinite value in palæontological reasoning; but the upheaval of these various hypothetical continents is by no means the only way of explaining known phenomena in accordance with it. It therefore seems reasonable to expect some physical evidence in confirmation of their former existence, and unless this evidence is forthcoming I should much prefer another explanation if supported in that way.

I shall now endeavour to make clear an explanation of the phenomena which have hitherto required the aid of an Atlantis and a Lemuria, treating them as belonging to one category. This hypothesis will also explain certain facts requiring elucidation by any theory framed to account for the peculiarities of the Swiss miocene flora, and will, I hope to be able to show, accord with others which have, apparently, no necessary connection with the subject.

I have stated that the Atlantis theory was founded on the similarity of the miocene flora of Europe to the recent flora of America. According to Dr. Oswald Heer, 186 species of miocene Swiss plants have their nearest allies living in the United States, 40 in tropical America, 6 in Chile, 58 in Central Europe, 79 in the Mediterranean region, 108 in Asia, 25 in the Atlantic Islands, 26 in the rest of Africa, and 24 in Australia. This analysis, by a strenuous and able advocate of the Atlantis theory, shows that there are other facts to be explained besides the preponderance of American types. Dr. Asa Gray, therefore suggested that the plants had travelled by way of Japan, Northern Asia, and Asia Minor to Europe, instead of across the Atlantic over a great island-continent, and this theory has been received with great favour by geologists like Sir Charles Lyell, and botanists like Professor Oliver. The latter gentleman, indeed, has ably seconded Professor Asa Gray in attempting to show that the plants travelled by the longer rather than the shorter route, and in comparatively high latitudes.* It will be unnecessary for me to do more than mention some of the chief features of his analysis of the three recent floras, namely, of Europe, Japan, and the Southern United States, in so far as they are allied to the Swiss miocene flora.

Of the miocene plants of Switzerland there are 76 genera common to the recent flora of Europe, 88 to that of the Southern United States, 77 to that of Japan, and 123 which occur in the united floras of Europe and Asia. The 77 genera

* *Nat. Hist. Review*, 1862, p. 149.

common to Japan include 26 not recent in Europe, and several of these are eminently characteristic tertiary types. Taking the orders of the Swiss miocene plants, 73 are common to the Southern United States, and 71 to Japan; but while 6 of the largest Japanese orders are represented in the Swiss miocene, there are only 4 of the largest American. The inference therefore appears natural and legitimate that the larger the group which is taken as the basis of the comparison, the smaller is the preponderance of American types; and considering the nature of many so-called species of fossil plants this fact has a remarkable significance. Professor Oliver also uses as a basis of comparison the proportion of ligneous species in each flora, and he finds that while about 40 per cent. of the Japanese flowering plants are ligneous, only about 22 per cent. of the American come into that category. The proportion of ligneous species in the Swiss miocene flora is even larger than in the Japanese, amounting to 60 per cent., and the former therefore corresponds more closely in this respect with the latter than with the flora of the Southern United States.

The foregoing facts seem to render reasonable the expectation that the true explanation of the affinity of the Swiss miocene plants to those of the Southern United States should, at the same time, account for its correspondence with that of Japan, and for the occurrence of allies of other species in different parts of the world. The Atlantis hypothesis does not answer this expectation; but a modification of the theory of an Asiatic route does. On natural history grounds, therefore, we should prefer the latter.

Another consideration to which I must direct attention, is the direction in which the migration took place. Hitherto it has been taken for granted, that the migration was *from* America *to* Europe during the miocene period, that is to say, the American flora being stationary, it spread during the miocene period as far as Europe. The Ex-President of the Geological Society, Mr. W. J. Hamilton, is, I believe, the only geologist who has ventured to dispute this assumption, and he has characterized the idea of a recent flora migrating to an ancient as a physical impossibility.*

I have just stated the assumption rather differently, and, put in that way, it does not seem impossible; still, I venture to support Mr. Hamilton's view, that the Swiss miocene plants emigrated towards America, and that during the emigration, many became dispersed to other regions; but, at the same time, I believe, on palæontological grounds, that they came from that continent at an earlier period.

In any area undergoing great physical changes, such as

* *Quarterly Journal of the Geological Society*, vol. xxi. p. 94.

Europe underwent during the tertiary period, there must also be great changes taking place in its fauna and flora. Consequently we find that the eocene flora of Europe is largely Australian in its character,* that the miocene flora is largely American and Japanese, and that the miocene shells are largely East Indian.† Respecting this last character, I have shown that the only legitimate inference to be drawn from it, is that the mollusca emigrated from Europe in a south-easterly direction; and this conclusion is borne out by the fact, that some still exist in the Mediterranean and Red Seas, having been left behind by the less hardy species, for the emigration was no doubt chiefly the result of the climate having become colder, in consequence of physical changes. This cooling of the climate of Europe began towards the close of the eocene period, for while the eocene fauna and flora were purely tropical, the miocene were scarcely more than subtropical, and the pliocene hardly more than temperate in some regions and much colder in others.

It is worth remarking, that the emigration of animals and plants from Europe seems to have taken place more constantly towards the east than in an opposite direction; witness, for instance, the affinity of the Australian mammals to those of our oolitic rocks, the affinity of the eocene European plants to the Australian recent, and the likeness of the European miocene flora to the recent American and Japanese. The tertiary character of the American cretaceous plants is notorious, as is the miocene (European) and recent (American) character of the eocene flora of that continent; I believe, therefore, that our miocene plants came from America during the eocene period, and that their progenitors were the plants of the eocene and cretaceous periods in America, from which have also descended the recent flora of that continent.

If these views be admitted, the large number of Swiss miocene species represented in America is naturally explained, for the American plants had a double chance of preserving their likeness to their descendants. Again, if the present flora of America (or that from which it has descended), has existed on that continent ever since the cretaceous period, we ought to find the remains of it imbedded in leaf-bearing strata of all succeeding periods in America, if such deposits exist. At present, this crucial test is not available for periods later than the eocene; but the evidence at our command bears out, as we have seen, the views I am advocating.

* Ettingshausen—*Ueber die Entdeckung des Neuholländischen Charakters der Eocenflora Europás*, 1862. Unger—*New Holland in Europa, and Journal of Botany*, No. 26.

† See *Quarterly Journal of the Geological Society*, vol. xx. p. 63.

At present, the miocene Atlantis theory has received no confirmation from students of physical geology; we have no evidence of such vast changes in the physical features of the Atlantic having taken place since so recent a date as the miocene.* On the other hand, the modifications of it which I have just enunciated are well sustained by known geological, as well as palæontological data.

In studying the distribution of the cretaceous and nummulitic strata of the Old World, one cannot avoid remarking their persistent east and west extension, in temperate and northern sub-tropical regions. We thus find them occurring in southern Europe from Portugal to the Black Sea; and, in Asia, from Asia Minor as far east as geological researches have been made. These and other facts, especially the east and west direction of the lines of volcanic disturbance of the same periods, induced Mr. Searles Wood, jun., to promulgate, in 1862,† his view of a land-connection between America and the then existing Europeo-Asiatic continents at the close of the cretaceous period and the dawn of the tertiary. We have seen that this hypothesis accords remarkably well with one section of the palæontological facts which it is our endeavour to explain; it now remains for me to show that other phenomena can likewise be explained by the same theory.

I have already stated, in general terms, the grounds on which Dr. Sclater was led to promulgate his theory of the ancient continent Lemuria. As instances of the peculiarities in the fauna of Madagascar, sought to be accounted for by this "hypothetical continent," I may mention, quoting Dr. Sclater,‡ that the Insectivora of that island are most nearly allied to the American genus *Solenodon;* that the frugivorous bats of Madagascar belong to the Indian section of the group, and not to the African; and that certain American forms of serpents and of insects are also found in Madagascar, while the characteristic members of the African fauna are entirely absent from the island. Dr. Sclater also states that the lemurs of Africa are abnormal when compared with those of Madagascar; but that those of India appear to form in some respects an intermediate group. The theory he has proposed, does therefore account for the facts he wished to explain; but the question to be solved is its admissibility on other grounds.

In the proceedings of the Zoological Society for 1868, Mr. H. W. Bates gave an analysis of the affinities of eleven families of the coleoptera and lepidoptera of Madagascar, and referred also to Dr. Hartlaub's analysis of the birds. The general

* See Lyell's *Elements*, 6th Edition, p. 267.
† *Phil. Mag.*, 4th Ser., vol. xxiii. p. 277.
‡ *Quarterly Journal of Science*, No. 2, pp. 213, *et seq.*

result is the same as that arrived at from a consideration of other classes of animals, namely, that there exists a large number of genera and species peculiar to the island, certain others common to it and to Africa, some allied to Asiatic types, and a few having tropical American affinities. The proportions differ, of course, in the different classes, owing to a difference in the powers of locomotion and other causes.

Dr. Hartlaub had previously hinted at the connection of Madagascar with South-Eastern Asia, rather than with Africa; but Mr. Bates rightly observed that if the Asiatic element justifies such a conclusion, the American ought also to be taken into account. This suggestion, as we have seen, has since received its complete development at the hands of Dr. Sclater.

Mr. Bates's own idea is "that the island (whether previously stocked with anti-African forms or not) was at one time much more closely connected with Africa than it now is, and that the time of connection was anterior to the date when the continent became peopled by *Simiidæ*, and the bulk of its present mammalia; but posterior to the introduction of lemurs." With this opinion I entirely agree.

Palæontology is not yet in a position to furnish us with any complete evidence on the question; but some few facts are known which seem to bear on it. The mammalia which existed in eocene and miocene times include forms, such as *Didelphis*, that are now restricted almost entirely to America, with others now South African and Asiatic in their affinities; but these types, geographically distant at the present day, have a very striking stratigraphical distribution in the tertiary deposits of Europe. As examples I may quote the following: In the eocene strata we have the genus *Chæropotamus* most nearly allied to the peccari of America; a species *Didelphis*, the opossums being now confined to that continent; and such genera as *Coryphodon*, *Pliolophus*, *Hyracotherium*, *Palæotherium*, *Lophiodon*, *Anoplotherium*, etc., all tapiroid pachyderms more or less allied to the tapirs of South America.

Miocene deposits have also furnished the remains of some interesting mammalia. I may especially quote two genera of old-world monkeys from Eppelsheim, named respectively *Pliopithecus* and *Dryopithecus*, so that here we get the first indication of true eastern types. The *Macrotherium*, a gigantic sloth allied to the old-world genus *Manis* was also obtained from the same deposit. The genus *Dinotherium*, a miocene ally of the tapirs, has hitherto been recognized only in strata of that period; but great interest is attached to it from its having been obtained from a locality so far east as the Gulf of Cambay. The genus *Mastodon*, which appeared first in miocene times, has

a still greater geographical range, several species of it having been obtained from both hemispheres.

Unfortunately no species of lemur has yet been discovered in the fossil state, although it is in accordance with all analogy to infer that they existed during the tertiary period.* New-world monkeys of pliocene age have been found in South America, but not elsewhere; and old-world monkeys have been found in Europe, as we have seen, and in Asia in miocene and more recent deposits. So far as we know, therefore, new-world monkeys never have existed in the old world, nor old-world monkeys in the new; and we have no certain record of any quadrumana during the miocene period. Had the Atlantis existed during the miocene period, it would be strange to find the distinctive features in the distribution of the monkeys of the two hemispheres still preserved; but if the Atlantis was of eocene date—before monkeys lived on the existing continents—then the differences in the distribution and structure of the *Catarrhini* and *Platyrhini* cease to be marvellous.

These facts show that it is possible to account for the American affinities of certain of the vertebrates of Madagascar by supposing their ancestors to have come to Europe from America by the eocene Atlantis, and to have travelled thence to India, Africa, and Madagascar at a later period. The affinities of the European tertiary insects are in favour of this view, which is also curiously confirmed by the fact that the lemurs, which are not known in the fossil state, are confined in the living state to the old world; and if they are ever discovered fossil, it probably will be in the eastern hemisphere; while most, if not all, of the Madagascarian animals having allies in the new world are known to have been represented, more or less closely, in eocene and miocene times.

There is no physical evidence in support of the hypothetical continent Lemuria, while, as we have seen, the eocene Atlantic continent was suggested by Mr. Searles Wood, junior, almost entirely on physical grounds. That India may have been connected at some not very remote period with the Mascarene Islands, Madagascar, and Africa, is, however, extremely probable. Such a connection no doubt existed when the *Glossopteris* flourished in South Africa, Central India, and Australia, and it may have continued to a comparatively recent period, or have been reproduced in tertiary times, or the connection may have been similar to what exists at present.

Our knowledge of the geology and palæontology of Mada-

* Prof. Rütimeyer has announced the discovery of the remains of an eocene monkey allied to the lemurs; but although this fact would add considerably to the strength of my argument, caution forbids me to quote it until its truth has been placed beyond doubt.

gascar is so extremely scanty and indefinite that we cannot quote a single fact derived therefrom in support of either view; but doubtless future discoveries will prove the probability or the impossibility of the hypothesis I have here advocated. I will just venture to anticipate one element of uncertainty in future inquiries into this subject, namely, the probability of a great Pacific continent having formerly united the old and new worlds on that side, for we know that that great region is even now an area of depression. It seems probable, however, that this consideration would more nearly affect the relation which formerly existed between Australia and South America, than the regions which now concern us.

In the foregoing pages I have endeavoured to establish the following conclusions:—

1. That hypothetical continents belong to two categories; namely, first, those supported by physical evidence, and, second, those unsupported in that respect.

2. That while the miocene Atlantis and Lemuria come into the second category, the eocene Atlantis and the possible Pacific continent come into the first.

3. That the theory of a miocene Atlantis and that of Lemuria each explains only one portion of the palæontological facts that call for elucidation; while the theory of an eocene Atlantis explains the whole of the facts of both cases.

4. That for these reasons it is probable that the miocene fauna and flora of Europe came from America during the eocene period by way of the eocene Atlantis; and that since the miocene period they spread over Asia and Africa and the eastern seas, and that a part of the flora returned to America by way of Northern and Central Asia and Japan.

5. That the fact of American cretaceous and eocene plants uniformly occurring in older deposits than a European palæontologist would, *à priori*, consider possible,* is of itself a most remarkable confirmation of two theories; namely (1), that organisms have migrated from west to east (*e.g.*, from America to Europe in eocene times); and (2) that deposits in the old and new worlds should be treated as homotaxeous,† and not as contemporaneous.

* See Dana's *Manual of Geology*, p. 510.

† *Quarterly Journal, Geological Society*, Vol. xviii., p. 52; and *Quarterly Journal of Science*, Vol. ii., No. 8, p. 622.

THE PERSISTENCE OF LUMINOUS IMPRESSIONS.

BY THE ABBÉ LABORDE.

THE following paper is translated from *Comptes Rendus*, 16th July, 1866:—

"When a luminous point strikes the eye and suddenly disappears, the sensation which it produces does not become immediately extinct, and according to the researches of some physicists, it remains for about one-third of a second, from whence arises all the phenomena known and explained under the title of *persistent luminous impressions*.

"It occurred to me to inquire whether in white light all the component colours had the same degree of persistence, and to study this question I submitted the sensation of light to an experiment which revealed to me a very curious fact, which seems to demonstrate that in white light the most refrangible colours are more persistent than the others, and that they act in advance of the others, so that the organ of vision decomposes white light by dispersing its colours in different times, just as the prism decomposes it by dispersing in different places.

"I make this experiment: the light of the sun is received upon a mirror which throws it horizontally on to a slit made in the shutter of a dark chamber. This slit should be three millimetres* wide and six long. Close to this slit, inside the chamber, a disk of metal is placed, on the margin of which, similar slits are made, with wide interspaces between them. A clockwork movement turns the disk, and a clamp, which the observer can operate upon at a distance, allows the revolution to take place with greater or less velocity. In the line of the light rays, at a distance of about a metre, a screen of ground glass is placed, behind which the modifications of the light can be observed when the disk is in motion. At first the light is made to appear or disappear slowly, and is found uniformly white; but when the successive appearances are made to take place more rapidly, the margins begin to be tinted, and by progressively increasing the velocity, the surface of the image becomes successively affected by blue, green, rose, white, green, blue. After this last blue, increasing velocities restore the whiteness of the light.

"The whole of the phenomena depend, as will be seen, on the varying periods occupied by the revolutions of the disk."

* In Darling's *Metric Tables* we find 3 mm = 0·118 of an inch.

M. Laborde does not give us any information on the rates of velocity which produce the different effects; but we apprehend those of our readers who wish to repeat his experiments will have little trouble in preparing the necessary apparatus, as the velocities required in the movement cannot be great.

GOSSIP ABOUT FISH.*

Mr. Couch's great work on British Fishes has arrived punctually at its termination in the fourth and concluding volume, which contains no less than seventy-three beautifully executed coloured plates. The entire work is enriched by two hundred and fifty-two coloured plates and numerous woodcuts. The illustrations thus afforded by Mr. Couch are the more valuable from being, with very few exceptions, drawn by his own hand from *freshly* caught specimens, and thus they are characterized by a degree of fidelity rarely attained in natural history works. Another highly important and valuable peculiarity of Couch's *British Fishes* is the large amount of information which it affords concerning the habits of the creatures described. Some of the older naturalists, with considerable talent for observation, were not sufficiently careful in description, and hence it is often difficult, and sometimes impossible, to identify the objects of their research. Since their days a new school has grown up, very careful in descriptive accuracy, and, we might add, very careless as to modes of life, and relations of habit to structure, which really constitute the essence of natural history, properly so called. Those who write as Museum naturalists may add very valuably to the means of identifying species; but unless their labours are supplemented by the observation of the field naturalist, they eventuate in nothing better than a long catalogue of names. Inaccuracy of description destroys the worth of field labours, because it leaves in doubt to what particular creature they were directed; but accurate description is of little value until some observer of habit, or some deep-thinking tracer of structural relations, has built up the raw material thus afforded into something that may be fairly dignified with the name of science.

The different dispositions and capacities of men naturally cause them to view external objects, and especially living ones, from two distinct points of view. According to one, and the

* *A History of the Fishes of the British Islands*, by Jonathan Couch, F.L.S. 4 vols. Groombridge and Sons, 1862—1866. Vol. i., fifty-seven coloured plates; Vol. ii., sixty-three, ditto; Vol. iii., fifty-nine ditto; Vol. iv., seventy-three ditto, from drawings by the Author.

most popular, because the apparently simplest, method of observation and philosophizing, every animal, for example, is supposed to be gifted with a special structure, *in order* that it may live under particular conditions and perform particular acts. According to another method of reasoning, the structure is the result of general laws operating under special conditions, and each animal belongs to a group, the whole of which must be studied before the individuals composing it can be understood; while the entire group has definite relations to other groups, and so on throughout the whole round of nature, which forms one great unity, in which Creative will and intelligence are displayed in conformity with an all-comprehending plan. Which ever mode of reasoning the tendencies of particular minds may lead them to adopt, the relation of habit to structure, or of structure to habit, is equally important; the difference being that the more philosophical and wider of the two systems give a proportionately ampler signification to every fact that is ascertained.

The fish, the reptile, and the bird, at first sight so different in appearance, and so apparently separated by a great gulf in structure as well as in habit, are found to grow nearer to each other the better they are understood.

Professor Huxley divides the vertebrate animals into three ascending groups; (I.) the *Ichthyoids*, comprising fishes and amphibia, defined by the presence of branchiæ or gills at some period of existence, nucleated blood corpuscles, and certain other peculiarities; (II.) the *Sauroids*, which have no branchiæ or gills at any period of their existence, nucleated blood corpuscles, certain peculiarities in the skull, and other structures, and which comprise reptiles and birds; and (III.) the mammalia.*

It is by tracing points of resemblance of too technically anatomical a character to be referred to in detail in this place, that Professor Huxley expresses the decision of comparative anatomists, when he speaks of the class of birds as "an ex-

* The passage stands as follows:—"The vertebrata are capable of being grouped into three provinces: (I.) The ichthyoids (comprising fishes and *amphibia*) defined by the presence of branchiæ at some period of existence, the absence of an amnion, the absence or rudimentary development of an allantois, nucleated blood corpuscles, and a parasphenoid in the skull. (II.) The sauroids defined by the absence of branchiæ at all periods of existence, the presence of a well-developed amnion and allantois, a single occipital condyle, a complex mandibular ramus articulated to the skull by a quadrate bone, nucleated blood corpuscles, and no parasphenoid, comprising reptiles and birds; and (III.) the mammals devoid of branchiæ, and with an amnion and an allantois; but with two occipital condyles and no parasphenoid; a simple mandibular ramus articulated with the squamosal and not with the quadratum with mammary glands, and with red non-nucleated blood corpuscles."—*Elements of Comp. Anat.*, p. 74.

tremely modified and aberrant reptile type;" and if the general reader will take for granted the connection between reptiles and birds, he will have no difficulty, from a slight knowledge of frogs in their tadpole and gill-breathing state, in carrying the argument further, and connecting reptiles, through the amphibia, with fish.

These considerations will serve to show that the fish are not so distinct and essentially different from other creatures as might have been supposed. The peculiarity of their abode marks them out with a certain conspicuous breadth of divergence; but several fishes can live for a time on dry land, and do so occasionally, by choice, while the whales represent mammalian life in the water, and the amphibia show how, at different stages of existence, the same animal may comport itself as a land reptile or as a fish.

From a survey of Mr. Couch's work, it becomes evident that the British coasts supply the naturalist with a great variety of species of fish, some occurring constantly in vast multitudes, and others, if not permanent inhabitants, visiting us sufficiently often to reward the attention of those who live near the sea.

The first volume of Mr. Couch's work discourses of the sharks and rays which belong to us or visit us, and concludes with delineations of sturgeons, sticklebacks, perches, basses, etc. The second volume contains, among other fishes, the gurnards, to which additional interest has been excited by recent researches into their capacity for producing vocal sounds. Mr. Couch gives sketches of several of their air-bladders, which are concerned in their vocal utterances. In the case of the piper (*Trigla lyra*), he says, "Several of the fishes of this genus are known to utter obscure grunting sounds when newly taken out of the water, and they continue them at intervals as long as they are alive." And, when speaking of the common gurnard (*Cuculus griseus*), he mentions its social habits, and tells us that "sometimes, in the fine weather of summer, they will assemble together in large numbers, and mount to the surface, over deep water, with no other apparent object than the enjoyment of the season; and, when thus aloft, they move along at a slow pace, and rising and sinking in the water for short distances, and uttering a short grunt as if in self-gratification." In fact, they have a sort of musical water-party; and, possibly, if they heard some of the bipeds singing, they might not speak of the performance more respectfully than Mr. Couch does of theirs when he calls it "a short grunt." These assemblies of gurnards, and other gatherings of certain fishes that might be adduced, certainly indicate the presence of a social instinct much more distinctly

than the progress of many fish in shoals, which may result from a community of impulse, quite distinct from companionable qualities.

In Mr. Couch's third volume, comprehending mullets, wrasses, rocklings, flounders, soles, etc., we find many illustrations of greater mental powers than fish are usually imagined to possess. Thus, the grey mullet is singularly watchful against restraint, and tries to leap over obstacles in preference to passing through them. Mr. Couch says, "In the port of Looe, in Cornwall, there is a salt-water mill-pool of thirteen acres, that is enclosed on the side of the river by an embankment, and into which the tide flows through flood-gates that afford a ready passage for fish to the space within. When the tide begins to ebb, the gates close of themselves; but even before this has happened, the mullets which have entered have been known to pass along the enclosed circuit within the bank, as if seeking the means of deliverance, and, finding no outlet, they have thrown themselves on the bank at the side, to their own destruction." Mr. Couch adds, all writers agree in ascribing to this fish great quickness of hearing, and it has even been supposed that it is capable of the perception of particular sounds. The Cornish historian, Carew, had formed a pond on a branch of the Tamar, in which mullets were fed at regular periods, and they were drawn together to the appointed spot at the sound made by the chopping of their food.

The carps (described in Mr. Couch's fourth volume), like the mullets, can be brought together by sounds intimating that their dinner is ready, and they seem to be fish of a highly intelligent character, with more than the usual fishy allowance of brain. "According to Professor Owen, the average proportion of the size of the brain to that of the body in fishes is one in three thousand; but in the carp, according to Blumenbach, it amounts to one in five hundred, which is the same as is found in the 'half-reasoning' elephant." Why the elephant should be called "*half*-reasoning" we never could understand, unless human vanity cannot bear the notion of ascribing reason to any other animal than man himself. Reasoning may be logically correct as far as it goes, and as far as the materials at its disposal allow it to go, and then it is as much *whole* reasoning in a fish as in a Newton, though the results may be less grand. The disciples of old Izaak are well acquainted with the cleverness of the carp, and when we regard him as a highly-organized specimen of the finny tribe, it is the more remarkable to find that he may—to use a Paddyism—be frozen to death, and yet come to life again.

Sir J. Franklin, cited by Mr. Couch, is the authority for this statement. He says that in his voyage to the Polar Sea,

"the fish caught in their nets became so frozen that in a short time they formed a solid mass of ice; and by a blow or two of the hatchet they were easily split open, so that their entrails might be removed in one lump. But if in this frozen state they were thawed before the fire they recovered their animation. This was particularly the case with the carp, and he has seen a carp so completely restored after being frozen for thirty-six hours as to leap about with much vigour." Mr. Couch alludes to experiments of John Hunter, which had an opposite result, as the carp which he subjected to a freezing mixture was killed; and he observes, "if we are to suppose that the fish frozen by Sir J. Franklin were of the same time species as those of Hunter, the only explanation of the difference of result will be that the suddenness of the operation in the north prevented that exhaustion of vitality which was fatal in the other." We are also told that carp can be kept alive for weeks in a cool cellar, if the body is kept moist and appropriate food supplied.

The minnows seem to possess their full share of piscine mother wit and natural politeness. When they have discovered some dead animal substance, "they arrange themselves in the form of a ring, which has been compared to that formed by the petals of a flower, with their heads lower than the level of their bodies, and in this situation no one jostles another. But however peaceable among themselves, the circle must not be broken into by a stranger, for on the approach of such, the most powerful of the company will quit his station to drive him away, while his place is kept vacant by his companions until his return to the feast."

Fishes with filaments hanging from their heads have usually keen sensations of touch, and some species seem equally remarkable for fine scent, if, indeed, the fish sense residing in the nostrils be not a sort of taste. Thus Mr. Couch informs us that the loach has been seen to follow his food by scent, so as to have discovered it "when intentionally concealed from the mere influence of sight and feeling." With reference to fish hearing, Mr. Couch states that a shoal of pilchards have been known to sink and disappoint the fishermen at the firing of a heavy gun twenty miles off.

Many curious instances will be found in Mr. Couch's fourth volume of the skill evinced by the eel in surmounting obstacles in his migrations. It appears that he gets up rocks, climbs gate-posts in canals, and, as is generally known, occasionally takes a walk in the fields. "It is said to have been known to devour newly-sown green peas in a garden, and I have been credibly assured that one was found in a field of turnips at the distance of a quarter of a mile from a river." An eel keeps one

of his five senses, that of touch, in his *tail*, and Dr. Marshall Hall discovered a sort of supplementary heart in that curious situation, and he noticed that "the vessels which issue from the caudal heart appears to have a particular distribution to the spinal marrow." The vertebræ of the tail allow of great flexibility. Thus, they not only use their tails to collect information by their superior sense of feeling, but also as bands to grasp any object round which they can be twined. The conger eel uses his tail in the same way. "When taken on board a boat, and left undisturbed, the sensitive powers of its tail are employed in searching out the nature and limits of its prison, and then this organ is stretched out to lay hold of the gunwhale, by fixing its hold fast on which a reversed muscular action is put in force, and the whole body is turned overboard." A small blow at the root of the tail disables the creature.

Among the curiosities of the fish world which attract the constant attention of visitors to the aquarium-room in the Zoological Gardens are the pipe-fish, remarkable for their slender, worm-like bodies, elongated snouts, and the exquisite motions of their dorsal fins. These creatures are no less remarkable for their domestic habits, as the males perform the functions of nurses—*dry* we cannot say, considering the watery situation in which the duty is discharged. The greater pipe-fish and the red-nosed pipe-fish are, like kangaroos, marsupial animals so far as the males are concerned. Mrs. Pipe-fish hands her eggs over to the male, who puts them in his pocket, and hatches them in due time. The slit, opening into the pouch, is closed by adhesion of its lips, and opens again when the time has arrived for the infants to get out and see a little more of the world. The males of the ocean pipe-fish (and some others) having no pockets, carry the eggs about cemented to the abdomen. Concerning the snake pipe-fishes, Mr. Couch says, "When on our coast their actions are amusing, as with their slender and prehensile tails they lay hold of some loose and floating object, with the aid of which, and the anterior portion of the body free, they steer their wandering course by the wavy action of the dorsal fin."

Little is known concerning the sleep of fishes. Mr. Couch supposes that some of them go to sleep, if we so phrase it, a piece at a time—that is, that certain portions of the brain rest while others remain at work. He thinks the pike may be asleep when he lies so quiet and stupid as to be caught by having a wire noose laid over his nose; and that great monster, the sun-fish, may be "enjoying a snooze" when it is found lying on the surface of the water, and allows itself to be seized. The shape of this fish is very queer. It is a sort of blunt oval, very obtuse at the tail end, at which it is furnished with two

great spear-shaped fins. If awakened from its slumbers, its usual mode of escape is along the surface of the water with great swiftness, so that, in a case which Mr. Couch mentions, a rowing boat could not overtake it. Mr. Couch gives a beautiful figure of it, and informs us that when seen shining in the water, it is found to merit its sunny name. Our readers will remember its portrait, drawn in a former number, to illustrate its capacities for playing the part of host to some of Dr. Cobbold's vermicular pets.*

Among the queerest of queer fishes are the lampreys. They are of worm-like form, with soft bones, and mouths rather vertical than horizontal, which can be expanded, and act as sucking disks. The sea-lamprey is often found tightly adhering by its sucker mouth to a ship, and it has been supposed by some that it mistakes the sides of the vessel for something good to eat; while others consider that, without studying Bishop Berkeley, it has a high opinion of the virtues of tar, and adheres to the ship for the sake of that substance. The sea-lamprey is described by Mr. Couch as dining off its fellow-creatures after a fashion more skilful than kind. "The whole of the interior arch of the mouth is studded with regular rows of teeth, each one of which, on a broad base, is furnished with one or two apparently reversed points; and the teeth which are the most distant and concealed are larger than the others, and more effectually crowded with these points. For simply biting, as in other fishes, they are useless; but when the breadth of the open mouth is brought into contact with the surface of a fish on which the lamprey has laid hold, by producing a vacuum, these roughly-pointed teeth are brought forward in a manner to be able to act on it by a circular motion, and a limited space on the skin of the captive prey is thus rasped into a pulp and swallowed, so that a hole is made which may, perhaps, penetrate to the bones." The victims of this singular "diner out" cannot succeed in throwing off their tormentor; but they seem to get well of their wounds, and are ready, like the Abyssinian cows, when one slice has been taken away, for their devourers to come again. A more amiable trait in the lamprey character is the aptitude for matrimonial felicity at the spawning season. Both sexes then combine to excavate a trench at the bottom of a river, in which their eggs are to be deposited, and when a stone of considerable size is in the way, the sucker-mouth seizes it, and it is thrust on one side. Stones of even ten or twelve pounds weight are said to be turned over by the zealous pair, who no doubt experience satisfaction in the performance of their task. The lamprey figures in heraldry, and is occasionally met with as a surname, though what resem-

* Vol. ii. p. 82.

blance our forefathers could have discovered between the man who first bore the appellation and the creature itself, history, as known to us, does not record.

As we come to the conclusion of Mr. Couch's work, we find ourselves passing out of the fish world altogether, through those singular transition links—the myxine, or borer, and the amphioxus, or lancelet. The myxine, Mr. Couch tells us, is scarcely rare in our northern waters, especially about Scarborough, and is no favourite with the fishermen, as it attacks the fish caught on their long lines as soon as they are dead. The myxine is worm-like in aspect, and breaths by means of little vesicles or chambers, the lining of which forms folds. The spine is a cartilaginous tube, and the nervous cords lie upon it unprotected by bone. This creature enters the bodies of larger fish through the gills when they are dead, and devours their muscular structure very much as the lamprey feeds.

Older naturalists took the myxine for *a worm;* and the lancelet, another of the lower fishes, was regarded as *a slug*. This very curious creature is of small size, the largest Mr. Couch has seen being two inches and three-tenths long, with a depth of about three-tenths of an inch, exclusive of the fins. Its gelatinous vertebral column exhibits separate joints; but it has no skull and very little brain. It has no true gills and no true heart.

In taking leave of the fishes, we strongly recommend those who wish to acquire a general knowledge of them in a very agreeable way to turn over the pages of Mr. Couch's splendidly illustrated volumes, and glance at his descriptions. For strangeness and variety of form and beauty of colouring, fish are not surpassed by any other animals, and we have no doubt Mr. Couch will tempt many to become real students of fish under his able guidance, whose original intention went no deeper than to amuse an hour by looking through his plates.

LARGE BRITISH OAKS.

Modern discoveries have enlarged our notions on the size of trees as well as many other subjects, and it is now no longer a doubt that, in proportions of height and expansion, there are those both in the old and new world that can look down with dimensions of superiority upon our ancient standards, the cedars of Lebanon.

From time immemorial, the natives of the British Isles have justly boasted of their oaks; since the days of the Druids, who bore an identical name with them and abode beneath them, down to the present generation, The idea of them is associated with bulk, elevation, strength, durability, and stateliness: they are the monarchs of the forest. Until metal was substituted for wood, the universal testimony of ages concurred in assigning a decided preference to their employment in the most important services. To them, under Divine Providence, has been ascribed not only the feeling, but the actual existence of that national security that England has enjoyed from her "wooden walls." Iron, it is true, has recently waged war against oak in several ways—in the construction of our dwellings, as well as of those floating habitations or castles that, under various forms, have been applied, in conjunction with steam, to the circulation of commercial enterprise as well as to the protection of our shores.

Leaving speculation, however, and coming to matter of fact, while we consign the discussion of the *genus Quercus*, and the relative merits of its different species to the naturalist, and the comparative growth of other trees in other regions to the traveller, let us descend to some notable proof of what the English oak is capable of producing for our use, in justification of the ground of a preference cherished for a time, "whereof the memory of man runneth not to the contrary."

What has been remarked of the cow among the "beasts of the field," that it contains no part or property, living or dead, that is not in some way or other convertible to the use of man, may, with little exception, be fairly predicated of the oak among "the trees of the forest." Shelter and shade, and the acorn while living; bark, fuel, and material of the best and most enduring quality when the axe has laid it low. Whatever of it is undecayed is applicable to useful purposes. The term *materies*, by which the Romans designated timber in general, is eminently descriptive of the product of this noble and valuable gift of the Creator to man.

Of the particular value, variety, and extent of its application some notion may be formed by the selection, among

many others that might be made, of two striking examples. They consist of trees that grew in the county of Monmouth, a part of this island so abounding in them for ages that, even at a late period, they obtained the appellation of "the weed of the soil." Diminished in size and number by thinning out, and the facility of removal through railroad accommodation, they still flourish innumerable amidst the hills and valleys of that beautifully diversified region. Specimens, both here and elsewhere, may no doubt be found upon record that may have exceeded the largest to which we are referring; but they both appear so remarkable, on account of the ends to which they were applied, that they deserve to be rescued from oblivion. The first and smaller of the two was called

THE BRYNGWYN OAK.

Bryngwyn (signifying the White Hill) is a term of frequent occurrence in Wales and on the borders. In this case, the estate on which this tree was felled, in 1791, is near Raglan, and was then the property of William Morgan, Esq. Its price was forty guineas, and its dimensions and various distributions on dissection were thus minutely described by the purchaser:—

Bark, 3 tons, 17 cwt., 2 qrs.
Cordwood, 31 cords, 3 qrs.

Cooper's timber, from slabs, etc.

84 hogshead staves.
67 barrel staves.
106 kilderkin staves.
256 cooper's ends,
28 hogshead heads.
38 barrel heads.
49 kilderkin heads.

	FEET.
Butt-piece 31 feet long, when sided to upper piece of stem	330
From the two slabs, 216 feet of knees, sided square from the angle	216
1 branch, 29 feet long, siding 17 inches . .	58
1 ditto 24 ditto by 19	60
1 ditto 19 ditto by 17	38
13 sided knees	217
When converted	919

In the square state.	FEET.
One piece growing from the side, about 12 feet from the ground, squared in nine pieces .	106
One piece damaged by felling	52
23 ends of crooks from different branches not less than 6 inches in girth . . .	118
Or 29 tons, 35 feet . . .	1195

This account, somewhat irregular in its arrangement, though there is no reason to think inaccurate as to number, weight, and measure, appears by itself somewhat extraordinary, but is marvellously surpassed by the next example, that in gigantic proportions may be said literally to *cast it into the shade*. The ensuing statement, put into the hands of the writer of this article, some years ago, by one who was resident near the place where this enormous tree grew, is detailed in a different but more satisfactory form. Like the preceding, it stood on an estate from which it took its name of

THE GOLYNOS OAK.

Golynos is about four miles from the town of Newport, and is in the parish of Bassaleg. The tree was purchased by his Majesty's Purveyor of Plymouth Dockyard and Dean Forest, in the year 1810, for one hundred guineas, and was felled and converted in the same year. Five men were each twenty days stripping and cutting it down, and a pair of sawyers were constantly employed one hundred and thirty-eight days in its conversion. The expense of stripping, felling, and sawing, exclusive of superintending the conversion or hauling any part of it, was eighty-two pounds. It was felled in separate parts, and stages were erected by the workmen to stand on to cut down the valuable limbs. Previous to being felled it was divested of its brushwood, which was placed as a bed to prevent the timber from bursting in falling. The main trunk of the tree was nine feet and a half in diameter, and consequently no saw could be found long enough to cut it down; two saws were therefore brazed together. In cutting the main trunk through, a stone was discovered six inches in diameter, six feet from the butt, and three feet in a diametrical direction from the rind, round which the timber was perfectly sound. The rings in its butt being reckoned, it was discovered that this tree had been improving upwards of FOUR HUNDRED YEARS! and, as many of its lateral branches were dead and some broken off, it is presumed that it must have stood little short of a *century* since it attained maturity. When

standing it overspread *four hundred and fifty-two square yards of ground.* Its produce was as follows :—

	FEET.
Main trunk, at ten feet long . .	450
One limb	472
One ditto	355
One ditto	235
One ditto	156
One ditto	113
One ditto	106
Six smaller ditto	413
Dead limbs of the size of timber .	126
Total quantity of timber . .	2426

Its conversion was thus :—The main trunk was cut into quarter boards and cooper's stuff; the limbs furnished one upper piece-stem for a hundred-gun ship; one ditto, fifty guns; one rother (rudder?) piece, seventy-four guns; three lower futtocks, each one hundred guns; one fourth futtock, one hundred guns; one ditto, seventy-four guns; one ditto, forty-four guns; one floor-timber, seventy-four guns; one second futtock, one hundred guns; and about twenty knees, all of which were large enough for the navy. The heavy body-bark was three inches thick. When all its parts passed into the market, they produced nearly six hundred pounds! What compression, what expansion from a single seed, weighing probably less than a quarter of an ounce, and contained with ease in the hollow of the human hand!

The secret of the growth and magnitude of these and similar specimens is, that for the most part they were solitary beings, that spread out their limbs without any neighbouring opponent or control. Such as these, rearing their heads aloft on the wide common or wayside green, charm the eye of the lover of nature's beauties, who deplores the utilitarian feeling that imperils their lives. Their majesty and beauty conspire to seal their doom; the contractor and carpenter see nothing in them but pounds, shillings, and pence, and they are gradually disappearing by the railway at hand. All things must yield to traffic in a money-getting age; but the exertions of the poet and the painter will still survive the destruction wrought by man and time.

"Everything," says Epictetus, "hath two handles." Your readers, Mr. Editor, will be differently affected by the representation of the fate of these objects. There may be those who think they could not be appropriated to a better purpose; on the other hand, there are those who, if they had their own

way, would gladly have spared them till they perished by decay. All do not view the same object in the same light, and it is well for the general good that it should be so. Each has thus his share in it.

It happened to the writer many years ago that he was riding in company with several persons, among whom was the celebrated author of the *Essay on the Picturesque*, together with a simple country squire, whose ideas and admiration of forest scenery centred in trees as timber. "What a charming effect," said the lover of pictorial beauty, "do those masses of foliage produce!" "Yes," added the other, "but the trees are worth next to nothing in the market." The man of taste turned round with a glance of disapprobation, and was silent at the moment, but could not refrain from expressing apart his disgust and indignation at such an absence of feeling; and yet each in his own way was not far from right.

Sir Uvedale Price, Bart., the person alluded to, a man of taste and a scholar, was an enthusiastic lover of forest scenery, as his oaks at Foxley, near Hereford, bore ample testimony. He used to prune them regularly, in part, with his own hand, and had under him a set of pruners who worked beneath his own eye. On the loss of one of them he expressed his regret to the writer in the words employed by Priam on the death of Hector, Ὅς δέ μοι ὄιος ἔην (*Iliad*, Ω), such was his zeal for the care and cultivation of the oak.

A taste of this kind seems to have been inherent in the family. Colonel Price, a brother of the above gentleman, was a great and deserved favourite of George III. An anecdote is related of him that the King, intending to have a certain tree taken down, asked the Colonel's advice respecting it, at the same time expecting to meet with a ready acquiescence in the notion of its propriety. The Colonel, however, ventured respectfully to say that he was of a different opinion. "Aye," replied the King, somewhat hastily, "that's your way, you continually contradict me." "If your majesty," resumed Colonel Price, "will not condescend to listen to the honest sentiments of your faithful servants, you can never hear the truth." After a short pause, the King very kindly laid his hand upon the Colonel's shoulder, "You are right, Price, the tree shall stand."

J. W.

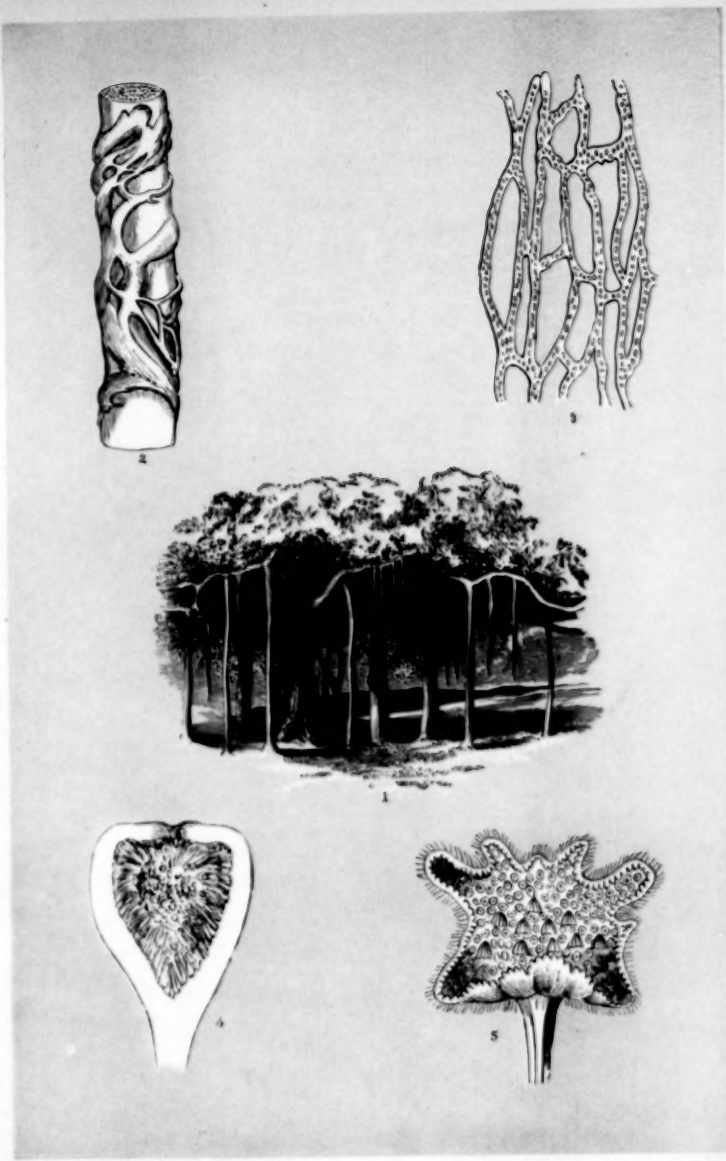
ON THE GENUS FICUS.

BY JOHN R. JACKSON,

Curator of the Museum, Royal Gardens, Kew.

(*With a Tinted Plate.*)

We have before spoken of tropical forest trees, and in a previous paper in the Intellectual Observer, we gave a brief account of some of the most noble of the Australian forms; we also, in that paper, made a passing allusion to the denizens of the oriental forests. We purpose now to conduct our readers into some of these forests, or rather to introduce them to some of their inhabitants. Amonst the finest trees of purely tropical scenery, of course still excepting the palms, the members of the genus Ficus hold a prominent place. This genus belongs to the natural order Moraceæ, and is that also to which our common fig belongs, besides Morus itself, which includes the mulberry, Broussonetia, the paper mulberry, Dorstenia, and others. Though the order is small, it is a most important one, both in an economic point of view, and also in botanical interest. The genus Ficus is especially rich in many varied forms of useful products, for besides the fig itself, we have caoutchouc, lac, etc. Whether any of the species are European is a question upon which our best botanical authorities have differed. Lindley says that none of the Morads are European, and that the mulberry and common fig have both been brought from the East; other writers consider the fig to belong originally to Asia Minor, Persia, South-Eastern Europe, and North Africa. We can only say, that if not truly indigenous, the plant has become thoroughly naturalized in all the countries mentioned above. The way in which many of the species adapt themselves to circumstances in their mode of growth is peculiar, and very striking to an observer. In many cases we find them twining, and almost enveloping, colossal palm trunks, though they are capable of forming very thick trunks of their own, which frequently bear an immense spreading crown. The magnificent wild fig-trees of the East, indeed, are always regarded as the true friends of the sun-scorched traveller, affording, as they do, such a cool retreat, and such a complete shelter from the sun. Lindley says the genus Ficus is one of those which travellers describe as most conducing to the peculiarities of a tropical scene; and, quoting from the "Annals of Natural History," he says, "Mr Hinds points out the complex appearance of the main stem of many species; their immense horizontal branches, their proportionate lowness,



THE GENUS FICUS.

1.—Banyan tree, (Ficus Indica, L.)
2.—Palm encircled by F. Indica.
3.—Laticiferous tissue of F. elastica, Rox.
4.—Section of Common Fig, (F. carica, L.)
5.—Open receptacle of Dorstenia contrayerva, L.

and the vast number of smaller stems in every stage of development—some just protruding from the horizontal limbs, others hanging midway between the leafy canopy and the earth, displaying on each thick rounded extremity an enormous spongiole, while many reach the soil, and, having attained strength and size, act as columns to sustain the whole structure." The best example of this very peculiar provision for supporting so wide-spread a canopy is to be found in the Banyan-tree (*Ficus Indica*, L.) Fig. 1. This tree is certainly one of the most famous and interesting of all the East Indian forms of vegetation, and is the best type of the peculiar adaptability of the genus in forming irregular trunks, and that in a manner quite contrary to the usual mode of proceeding in the vegetable world. We all know that one of the laws of plant-life is to send its root downwards and its stem upwards, so that the former may take in from the earth the nutriment there stored, while the latter, developing itself by its natural appendages, performs the important functions of respiration. This, of course, in its infancy, is the case with the banyan; but after it has grown, and formed its crown of foliage by throwing out its branches, and while yet a young tree, these branches perform a double duty; for besides being the support of the leaves, they throw out again downward branches, which reach, and strike root in the ground, and then go on growing as true stems, thus forming a support for the spreading mass above. These trees are common all over the East Indies: and to such a size do they grow, that one tree forms a miniature forest in itself. The largest banyan-tree is said to be on the banks of the Nerbuddah river, where, for aught we know, it is still growing. Forbes, in his "Oriental Memoirs," says the circumference of the tree at the time of writing the account, was nearly 2000 feet, and the overhanging branches which had not thrown down their props or supports, stretched over a much larger area. The tree had as many as 320 main trunks, and over 3000 smaller ones, and was capable of giving shelter to 7000 men. These dimensions appear almost fabulous; there is, however, another fine tree at Mhow, which has sixty-eight stout stems, and can give shade, even under a vertical sun, to an immense number of men; indeed, we are constantly told that a regiment of cavalry can conveniently take refuge beneath one. For large assemblies or meetings they form perfect natural tents. It is very certain that these immense trees must be of great age; and we should naturally expect to find a full description of so remarkable an object in the works of the old classic authors. Strabo's description is both minute and accurate, as is also that of Pliny. The banyan has been the theme of poets in more recent times, as well as of travellers

and naturalists. Milton beautifully describes it in the following passage—

"Branching so broad and long, that in the ground
The bending twigs take root; and daughters grow
About the mother tree; a pillared shade,
High over-arched, with echoing walks between.
There oft the Indian herdsman, shunning heat,
Shelters in cool; and tends his pasturing herds
At loop-holes cut through thickest shade."

And Southey, in his "Curse of Kehama," says—

"'Twas a fair scene wherein they stood,
A green and sunny glade amid the wood,
And in the midst an aged banyan grew.
It was a goodly sight to see
That venerable tree.
For o'er the lawn, irregularly spread,
Fifty straight columns propped its lofty head;
And many a long depending shoot,
Seeking to strike its root,
Straight, like a plummet, grew towards the ground.
Some on the lower boughs, which crossed their way,
Fixing their bearded fibres round and round,
With many a ring and wild contortion wound;
Some to the passing wind, at times, with sway
Of gentle motion swung;
Others of younger growth, unmoved were hung
Like stone-drops from the cavern's fretted height.
Beneath was smooth and fair to sight,
No weeds nor briers deformed the natural floor;
And through the leafy cope which bowered it o'er,
Came gleams of chequered light.
So like a temple did it seem, that there
A pious heart's first impulse would be prayer."

Though habit has taught us to look upon the root of a plant as that part alone which is buried in the earth, we see there are such things as roots being given off from totally different parts. This occurs mostly, if not entirely, in tropical climates, and is effected greatly by the influence of moisture and shade, considering, of course, that the plants have a natural predilection for forming these aerial, adventitious, or secondary roots. The banyan is a good example of a plant producing aerial roots.

The structure of a true root, when fully developed, is very similar in all respects to a true stem. The epidermis, however, is without stomata, and the bark is always very thick, owing to the moisture it absorbs from the earth. Thus we find that stems of many plants are capable of forming roots, as is instanced by the growth of plants from cuttings, or by pegging a bent branch down to the ground. In the case of the banyan, so long as the roots are pendant, they derive their nourishment from the parent trunk, but so soon as they reach the ground,

the spongioles or absorbent parts of their roots become more developed, and strike into the earth, and then begin the necessary functions for increasing their diameter, and supporting the weight of the new foliage above. It is not at all uncommon to see the trunk of the talipot palm (*Corypha umbraculifera*), or the palmyra (*Borassus flabelliformis*), completely encircled by one of these figs. (Fig. 2.) This is caused by the seeds, which are very small, dropping into the axils of the leaves of the palm, where they vegetate, and send their roots downwards, embracing the trunk in their descent. In very old specimens, where these aerial roots have extended to a goodly diameter. the palm is seen emerging from the thickness of the fig, as if it was actually one and the same plant. These combinations are considered sacred by the Hindoos, who call them holy marriages. A white, glutinous juice exudes from the stem, which is considered a remedy in toothache; bird-lime is also manufactured from it, and an infusion of the bark is said to be a powerful tonic.

A small but very good specimen of the banyan-tree may be seen in the palm-house of the Royal Gardens, Kew, and a trunk of the talipot palm, encircled as described, is in the museum of the same establishment.

The Pepul (*Ficus religiosa*, L.) is also a native of the East Indies, and is remarkable for the long tapering points of its leaves, as well as the closely reticulated and strong vascular fibre. The Chinese make very pretty and effective ornaments of these leaves, by removing the cellular tissue or green pulpy matter, and covering the skeleton with a coat of varnish or gelatine, and then painting figures of birds, flowers, etc., on the surface. The ease with which the cellular tissue is removed by macerating, recommends the leaves of this species for the purpose of dissecting or skeletonising for leaf bouquets. Amongst the Hindoos, the pepul-tree is greatly venerated, their belief being that among the branches the goddess Vishnu first saw the light. The plants are, in consequence, frequently to be met with near houses, pagodas, etc., and the natives are very unwilling to cut them down. Birds devour the fruit with avidity; and in their flight, instances have been known of the seeds having fallen into the cracks of buildings, where they have germinated, and caused much damage. They are used in medicine by the native practitioners, as is also the bark. The leaves of the different species vary much in form, those of the pepul being heart-shaped, with the long slender point before spoken of, and seated upon long and slender petioles; they have a trembling motion in the air, very similar to that of the common aspen. They are a favourite food for silkworms.

Peculiar as the two species here enumerated are, the most

important of the Indian species, in an economic point of view, is *F. elastica*, Roxb. It is a tree growing some thirty or forty feet high, with large oval or oblong leaves, very thick and glossy, and is now well known as a common conservatory and parlour plant. The fruits are arranged in axillary pairs, sessile, or without stalks, not larger than an olive. From this species most, if not all, the caoutchouc or India rubber brought from the East Indies is obtained. We all know how abundantly a white milk flows from the least fracture occasioned to any part of this plant, the prick of a pin upon its stem or thick green leaf will cause it to ooze out, and by exposure to the air become thick and elastic. When collected in its native country for commercial purposes, deep incisions are cut through the bark nearly down to the wood, in a transverse direction, and about a foot apart. The juice flows from these wounds in large quantities, and, on coming in contact with the air, forms itself spontaneously into a solid elastic substance, from which a kind of whey or fœtid fluid separates. After such a tapping as this, the tree is said to require but a fortnight's rest before it is ready for a similar operation. The presence of caoutchouc or milky juices in plants is a character of many natural orders. Some yield a pure milky fluid, which never hardens. The vessels that contain this fluid are called laticiferous tissue, or cinenchyma. They are very minute, the average diameter of one of them not exceeding $\frac{1}{1400}$ of an inch. One of the chief distinctions of these vessels is, that they lie in no regular or definite position to the other tissue, and consist of long branching tubes, as seen at Fig. 3. In their young state, they are very thin and hair-like, but as they get older, they become large, their sides thicken, and contract in some places, and swell in others. This has given rise to an opinion amongst some botanists that they are merely a series of cells, placed end to end, in which the partitions have become absorbed, as there are no divisions through their entire length. The contents of these tubes, called the latex, is not in all plants milky, but sometimes coloured, and at other times quite transparent and colourless. It is always of a granular nature, but its chemical composition varies in different plants; for while some give a perfectly harmless, and even a nutritious milk, others are acrid and narcotic. The cells which contain caoutchouc, and similar juices, must therefore not be confounded with the cells or vessels through which the ordinary nutritive functions of the plant are carried on, nor must the fluid itself be confounded with the sap.

The common Fig (*Ficus carica*, L.) is perhaps the best known of all the species, owing to its valuable fruit. As we have before said, its native country is doubted. The plant is,

however, now cultivated to a very large extent in Turkey, and on the shores of the Mediterranean. It is a tree growing in favourable situations to a height of twenty or thirty feet. The plant is so well known in our gardens and greenhouses, that it would be needless to describe it. We may, perhaps, however, be allowed to say a few words about the fruit, as it is a peculiar, though a common one. We hear people speak of the "seeds" of the fig, meaning those little granular sago-like things so numerous inside a fig. These are not seed, which we should soon discover were we to examine them in a green fig. They are each of them a small individual fruit, which in this form is called an achene. The *Ficus carica* is not cultivated for the sake of its flowers, for though it does flower, and that profusely, we venture to doubt if there are many of us who have actually seen the flower. It is not showy, nor is it exposed, as most flowers are, to the air and light. In most of our common fruit-producing plants, we first behold the bud, then the expanded flower, which in time drops away, leaving the fruit to develop itself to the size limited by nature; but in the fig, what we call the fruit is not the produce of one flower, but of many. The fleshy part which we eat, is in botanical language called a receptacle. (Fig. 4.) There are, however, various forms of receptacles, and even in the same family to which the fig belongs; thus, for instance, in Dorstenia (Fig. 5), we have an open, somewhat irregular square receptacle, slightly turned up at the edges like a tray. In this genus the flowers are exposed, but are still numerous as in the fig. Another common example of an open receptacle is to be found in the sun-flower, and we have only to bring up the sides, and nearly unite them at the top, and we shall have the same form of receptacle as the fig, namely, a hollow one, with the inflorescence inside instead of out. This inflorescence is of both sexes, else fertilization could not take place; and it is worth noticing the provision of nature in placing the male flowers near the orifice, at the apex of the fruit, while the females are seated in the concave part below; by this arrangement, the pollen from the male flowers, in dropping, is more sure to fall on the stigmas of the females, as the figs themselves, in their earlier stages of formation, and when the flowers are fully expanded, are nearly always more or less upright upon the stalks which bear them, seldom drooping until after fertilization has taken place, and the receptacle has become swollen. It frequently occurs, however, that the stamens are imperfect and no pollen formed. A practice, called caprification, has been resorted to in the East to provide for this natural deficiency. A number of wild figs, which are often infested with a species of cynips, are strung on threads and hung above the

cultivated ones. When the insects escape from the former, they enter the latter by the orifice at the apex, and so, by carrying the pollen grains upon their wings or otherwise, fertilize the female flowers. This system, however, is not so generally adopted as formerly, as it is now considered to injure the quality of the figs. It appears to have been clearly understood and practised by the ancients, as it is fully described by Theophrastus and Pliny. The introduction of the fig into this country is by some writers attributed to the Romans, and by others not till the early part of the 16th century, on the return of Cardinal Pole from Italy. The very trees which he brought, and which were planted in the garden of Lambeth Palace, are said to have flourished for 300 years. There is, or at least was until very recently, several fine examples of very old fig-trees in the kingdom, some of them of very great diameter, proving that even in our climate the fig is capable of thriving, though a severe frost is liable to do it great injury. The south coast of England, however, appears to agree with it, and standard trees have been known to produce fruit in tolerable abundance.

There is yet another species of this interesting genus which we must just notice before taking leave of it, and this is the sycamine or sycamore fig (*F. Sycomorus*, L.). This is supposed by some to be identical with the tree into which Zaccheus climbed. If this is so, and the tree is to be identified with that mentioned in many passages of Scripture, it must have been of great importance among the Jews, though the fruit is small, and hardly worth eating compared with that of the common fig. The light wood of this plant is said to be almost imperishable, and served to make the cases of the Egyptian mummies. The genus includes about 200 species, but the few we have described are the most important in an economic point of view, the most peculiar, and the types of the genus generally.

RED STARS.

GREAT interest attaches to red stars, not only from their extreme beauty when seen through a good telescope in contrast with a dark clear sky, but also from the changes which many of them undergo. Our numerous readers who possess telescopes will therefore be gratified with the following abridged list of solitary red stars published by Dr. Schjellerup in the *Astronomische Nachrichten*, No. 1591. We have omitted all the stars he mentions below the eighth magnitude (except some of the variables), as ordinary telescopes cannot exhibit them satisfactorily; and in consideration of the wants of subscribers living in more southern lands, we have inserted many stars not visible in this country. Those who possess equatorial telescopes will find the red stars without difficulty, and those who are not so provided will be able to trace their position on a map, and thus learn where to point their instruments in search of them.

Dr. Schjellerup remarks on the general interest excited by red stars, and he observes that with few exceptions variable stars are reddish, either constantly, or at some period of their transition. When changes of colour occur at definite periods in variable stars we may expect that interesting information concerning them may be afforded by the spectroscope.

As the following list contains the great majority of the solitary stars mentioned by Dr. Schjellerup, it follows that the majority of these bodies at present known are of the eighth magnitude and upwards; and the reader will notice how large a proportion range between the seventh and eighth magnitudes. Sir J. Herschel mentions an 8·5 mag. star, RA. 12^h 39^m 15 D. —58° 55′ 7 as the "most intense blood red" of any star he has seen, and it will be found from the list that stars approaching this tint are rare. Observers who use reflectors for their observations will find the colours more exactly seen when a glass prism is used instead of a smooth mirror, and achromatic eye-pieces like those of Mr. Browning will (with reflectors) be more reliable than Huygheniun.

RA. 1860. h m s	Decl. 1860. ° ′	Mag.	
0 51 41	— 6 38,2	8	Schj. 340: *red.*
1 8 27	+25 1,6	8	Bessel: *red.*
1 9 42	+46 57,5	7·5	Argelander: *very red.*
1 10 15	+ 8 11,5	var.	*S* Pisc. Hind: *reddish.*
1 13 47	+ 6 17,0	neb.	h. 101: *red star.* 7.5. 45″ *s.p.* According to d'Arrest, in 1864, Sept. 25, this star was 9 mag.
1 20 32	—33 16,6	6	Cape Obs.: *most beautiful orange red.*
1 23 25	+ 2 9,5	*v*	*R* Pisc. Hind: *fiery looking.*

AR. 1860. h m s	Decl. 1860. ° ′	Mag.	
1 45 24	+69 30,8	8	Argelander: *very red.*
1 59 35	+ 0 46,5	7	Cape Obs.: *very red.*
2 8 10	+24 24,3	*v*	*R* Arietis. Winnecke A. N. 1224: *orange in max.*
2 12 18	— 3 36,6	var.	*o* Ceti. Cape Obs. *Very full ruby; sang.*
3 9 1	—57 50,9	7·5	Cape Obs.: *high orange or brick red.*
3 9 26	— 6 14,8	7	Bessel: *red.*
3 37 1	—10 3,0	8	Schj. 1132: *red.*
3 45 13	+60 41,6	5·5	Conn. d. T. XV.: *red.*
3 48 31	—15 19,2	8	Schj. 1216: *yellow red.*
4 13 46	— 6 34,9	7·7	Schj. 1375: *yellow red.*
4 14 9	+20 28,9	6·5	Radcliffe Obs. XIX.: *pale red.*
4 20 38	+ 9 50,8	var.	*R* Tauri. Hind: *red.*
4 21 32	+ 9 38,0	var.	*S* Tauri. Hind: *reddish.* Winnecke A.N. 1224: *no colour.*
4 26 45	—11 5,1	6·7	Schj. 1462: *yellow red.*
4 27 53	+16 13,5	1	*a* Tauri.
4 36 45	+67 54,8	6·5	Argelander Zone 80: *very red.*
4 42 45	+28 16,9	8	Cape Obs.: *a very extraordinary ruby*
4 44 37	+14 0,9	5	Conn. d. T. XV.: *red.* [*coloured star.*
4 46 5	+ 2 15,6	5·5	Conn. d. T. XV.: *red.*
4 48 14	+ 7 33,0	7	Conn. d. T. XV.: *red.*
4 51 22	+ 7 54,7	var.	*R* Orionis. Hind: *reddish.*
4 53 14	—15 1,2	var.	*R* Leporis. Hind's *crimson star.*
4 54 38	+ 0 30,9	6	Schj. 1615: *yellow red.*
4 58 10	+ 0 58,9	6·5	Hist. Cél. pp. 49 and 316: *red.* [*yellow.*
5 2 55	— 0 44,5	7	Knorre Acad. Sternk: *red.* Schmidt:
5 10 26	+39 11,5	7	h. 350: *very ruddy, almost orange coloured.*
5 11 35	+34 7,1	8	Cape Obs.: *very remarkably red.*
5 16 36	— 9 27,7	8	Schmidt: *very red.*
5 22 38	— 1 12,3	5	Hist. Cél. p. 251: *red.* Schmidt: *yellow red.*
5 24 1	+18 29,2	5·5	Conn. d. T. XV.: *red.* [*red.*
5 29 18	+10 56,7	7·5	Hist. Cél. p. 311: *red.* Schmidt: *yellow*
5 34 0	— 3 55,2	8	Schj. 1878: *red.*
5 35 0	+ 2 17,6	7·7	Schj. 1888: *red.*
5 36 40	+24 21,4	8	Markree Cat. I. p. 76: *very red.*
5 39 19	—46 31,4	8	Cape Obs.: *vivid sanguine red, like a*
5 47 36	+ 7 32,6	*v*	*a* Orionis. [*blood drop.*
5 49 32	+45 55,1	6	Hist. Cél. p. 142: *red.* [2 Observ.
5 55 15	— 5 8,5	7·7	Schmidt: *yellow red.* Schj. 2015: *red.*
6 2 12	+26 2,3	8	A. N. No. 77, p. 73: *reddish.* Greenw. Obs. 1863: *very deep crimson colour.*
6 17 29	+14 47,7	8	Bessel: *red.* Cape Obs.: *vivid red.*
6 18 4	—26 58,7	8	Cape Obs.: *very intense ruby coloured.*
6 23 26	— 2 55,9	7·7	Schj. 2236: *red.*
6 26 55	+38 33,2	6·5	Hist. Cél. p. 208: *red.* Cape Obs.: *superb orange red, very rich colour.*
6 35 17	—52 48,5	6	Moesta Obs. p. 103: *reddish.*
6 41 0	—20 36,0	neb.	h. 411: *the chief* * 8 *mag. is red.*
6 49 59	+70 55,6	6	Struve Obs. Dorp. II. p. 60: *sub-red.*
6 52 32	—48 31,6	5·5	Moesta Obs. p. 111: *reddish.*
6 56 8	—27 44,2	3·5	Piazzi 320: *sub-ruby.*
6 58 55	+22 54,9	var.	*R* Gemin. Radcliffe XV.: *red.* Auwers A. N. 1238: *pale red.*
7 0 9	—57 20,7	8	Bessel: *red.*

AR. 1860. h m s	Decl. 1860. ° ′	Mag.	
7 1 31	—11 42,6	7·5	Hist. Cél. p. 271: *red.* Argelander: *reddish.*
7 6 30	+59 9,7	7	Struve Obs. Dorp. II. p. 76: *red.*
7 7 11	+22 12,6	7·3	Radcliffe XV.: *very red.*
7 17 14	—25 29,7	7	Cape Obs.: *very intense fiery red.*
7 25 7	+ 8 36,8	var.	*S* Canis minoris. Hind 1856: *a fiery 8·5 mag.* Winnecke Astron. Nachr. 1224: *very red.*
7 34 33	+29 33,3	5	*σ* Gemin. d'Arrest: *reddish.*
7 34 38	+23 46,6	var.	*S* Gemin. Hind 1848: *bluish*, 1852: *reddish.* Winnecke Astron. Nachr. 1120: *deep orange.*
7 36 45	+28 21,6	1·5	*β* Geminorum.
7 40 54	+24 4,7	var.	*P* Geminorum. Hind 1848: *ruddy*, 1852: *bluish.* Auwers Astr. Nachr. 1238: *reddish or orange.* [*orange.*
7 53 16	—49 36,7	8	Cape Obs.: *rich brick red, inclining to*
8 8 51	+12 9,2	var.	*R* Cancri. Auwers A. N. 1238: *bright*
8 14 54	+ 0 17,0	8	Bond p. 253: *red.* [*orange.*
8 18 7	—37 50,2	6	Moesta Obs. p. 115: *reddish.*
8 27 45	+19 22,5	*v*	*U* Cancri. Winnecke A. N. 1224: *no colour.* Auwers A. N. 1238: *reddish.*
8 39 36	+ 0 9,3	8	Bond p. 245: *orange*: p. 255: *orange red.*
8 48 34	—10 50,4	8	Schj. 3282: *red.*
8 48 40	+20 23,0	var.	*T* Cancri. Bessel: *red.* Hind: *very red.* Winnecke Astr. Nachr. 1224: *blood red.*
9 1 54	—25 17,2	4·5	Argelander: *red.*
9 2 13	+31 32,1	6	Hist. Cél. p. 221: *red.*
9 28 42	—62 10,7	8	Cape Obs.: *very intense sanguine star, between scarlet and carmine red.*
9 37 10	+35 9,3	var.	*R* Leonis minoris. Schönfeld A. N. 1500: *yellow red.*
9 40 2	+12 4.6	var.	*R* Leonis. Greenw. Obs. 1861: *deep red.*
9 44 36	—22 21,8	6·5	Argelander: *red.*
9 49 44	—40 55,6	7·5	Cape Obs.: *scarlet; remarkably full rich colour. Three Obs.*
10 3 59	— 7 43,7	6	Hist. Cél. p. 152: *red.*
10 5 46	—34 38,0	7	Cape Obs.: *Scarlet. Three Obs.*
10 29 1	—38 50,6	6·5	Cape Obs.: *extreme orange, almost scarlet. Two Obs.*
10 30 12	—56 50,0	5·5	Moesta Obs. p. 117: *reddish.*
10 30 39	—12 39,5	6·5	Hist. Cél. p. 329: *red.* Bessel: *red.* Lamont Z. 316: *orange.*
10 34 41	+69 30,5	var.	*R* Ursæ majoris. Auwers A. N. 1238: *pale red.*
10 44 49	—20 30,5	6·5	Hist. Cél. p. 284: *decidedly red.* Argelander: *very red.*
10 52 36	—15 36,2	6	Argelander: *red.*
10 53 40	—17 34,4	8	Cape Obs.: *most intense and curious colour. Scarlet, almost blood colour.*
11 4 59	—81 1,9	8	Cape Obs.: *ruby, almost sanguine.*
11 10 55	+33 51,5	4·5	Conn. d. T. XV.: *red.*
11 33 55	+25 34,9	8	d'Arrest: *red.*
12 15 10	—74 44,0	8·5	Cape Obs.: *sombre red.*
12 23 22	—56 19,4	2	*γ* Crucis. Rümker: *red.*
12 25 4	+ 5 26,8	9·5	Ross Phil. Trans. 1861: *scarlet.*

AR. 1860. h m s	Decl. 1860. ° ′	Mag.	
12 37 48	+61 51,6	var.	*S* Ursæ majoris. Auwers A. N. 1238: *red or violet.*
12 38 32	+46 12,3	5·5	Hist. Cél. p. 385: *red.* d'Arrest: *red.*
12 45 24	+17 52,1	8	d'Arrest: *tawny (subfusca).*
12 51 11	+18 31,5	8	d'Arrest: *red.*
13 11 18	−22 25,8	3	Conn. d. T. XV.: *red.*
13 19 20	−11 58,7	5·5	Conn. d. T. XV.: *red.*
13 22 4	−22 33,4	var.	*R* Hydræ. Piazzi: *ruby.*
13 25 42	− 6 28,4	var.	*S* Virginis. Pogson, Radcliffe XV. p. 288: *vivid red.* Auwers A. N. 1238: *orange.*
13 42 44	+16 29,6	4	Argelander Abo Catalog: 1829 *Maii* 12, *noted as red.*
13 47 13	+41 1,8	7	d'Arrest: *tawny.*
13 57 40	+ 0 12,8	8	Bond p. 281: *reddish.* [*brick red.*
13 59 13	−59 3,5	8	Cape Obs.: *double equal. Both stars*
14 6 53	−59 15,6	7·5	Cape Obs.: *ruby, or high orange.*
14 9 17	+19 54,8	1	α Bootis.
14 17 25	+ 8 43,6	6	d'Arrest: *fulvous.*
14 17 53	+26 20,6	7·5	Cape Obs.: *vivid red; almost a bright ruby colour; fine.*
14 22 22	− 5 21,4	8	Schönfeld Neb. Cat. pp. 66 and 68:
14 25 48	+31 59,3	4	Conn. d. T. XV.: *red.* [*reddish.*
14 28 55	+37 14,6	6	Hist. Cél. p. 164: *red.*
15 0 58	−69 32,8	6	Cape Obs.: *almost scarlet. Two Obs.*
15 9 19	−29 37,8	4·7	δ Lupi. Greenw. Cat. of 1439 stars: *very red.*
15 10 37	−75 25,1	7	Cape Obs.: *very high red, or ruby.*
15 15 6	+14 49,2	var.	*S* Serpentis. Winnecke Petersh. Bull. III. p. 176: *red.*
15 29 59	+15 34,0	7·5	d'Arrest: *red.* [*reddish.*
15 42 49	+28 35,3	var.	*R* Coronæ bor. Auwers A. N. 1238:
15 44 15	+15 33,7	var.	*R* Serpentis. Winnecke A. N. 1224: *remarkably red.* Auwers A. N. 1238: *not very red.*
15 59 56	+18 45,1	var.	*R* Herculis. Auwers A. N. 1238: *red.*
16 1 19	+22 12,1	7·5	d'Arrest: *reddish yellow.*
16 18 57	−12 5,9	8	Cape Obs.: *dull brick red.*
16 19 37	+19 12,8	var.	*U* Herculis. Schönfeld A. N. 1523: *red.*
16 20 50	−26 7,1	1·5	α Scorpii.
16 31 39	−32 5,8	8	Cape Obs.: *deep red, like a drop of*
16 43 57	− 5 56,0	8	Schj. 5990: *red.* [*blood.*
16 45 31	+15 10,8	var.	*S* Herculis. Auwers A. N. 1238: *red.*
16 52 26	− 4 0,4	8	Schj. 6046: *yellow red.*
17 8 16	+14 33,2	var.	α Herculis.
17 14 33	−28 0,2	6	Argelander: *reddish.*
17 30 31	−41 32,3	8	Cape Obs.: *beautiful ruby red.*
17 31 17	−57 39,0	8	Cape Obs.: *brilliant scarlet, or very high orange.*
17 36 43	−18 35,5	8	Cape Obs.: *remarkably red.*
17 51 2	+ 2 44,3	7·5	Cape Obs.: *a very fine orange star.*
17 59 7	+ 7 5,3	8	Schj. 6539: *red.*
18 1 41	−15 18,1	8	d'Arrest: *red.*
18 12 18	+ 0 47,3	8	Cape Obs.: *a very red star.*
18 21 59	+ 6 12,7	var.	*T* Serpentis. Baxendell Monthly Notices XXI. p. 68: *deep yellowish red colour.*

AR. 1860. h m s	Decl. 1860. ° ′	Mag.	
18 14 59	+ 0 5,7	7·5	Bond pp. 39 and 309: *red.*
18 24 44	−14 57,6	6·5	d'Arrest: *red.*
18 25 40	— 5 15,7	7·5	Schj. 6803: *red.*
18 30 58	−13 53,8	8	d'Arrest: *red.*
18 35 8	+ 0 1,5	8	Bond p. 41: *red.*
18 52 9	+14 10,2	8	Lamont Z. 199: *red.*
[18 56 55	— 5 53,4		Knott: *fine crimson.*]*
18 59 38	+ 8 1,2	var.	*R* Aquilæ. Auwers A. N. 1238: *red.*
19 2 47	+23 57,6	7	Conn. d. T. XV.: *red.*
19 8 29	−19 33,0	var.	*R* Sagittarii. Auwers A. N. 1238:
19 23 20	— 3 4,7	7	Lamont Z. 258: *red.* [*reddish.*
19 26 17	−16 40,4	7	Cape Obs.: *high scarlet or good ruby colour. Two Obs.*
19 26 30	+76 16,9	6·5	Argelander: *very red.*
[19 33 4	+49 53,2	var.	*R* Cyni. Knott: *colour remarkably fine*
19 37 35	+ 4 37,8	8	Schj. 7372: *red.* [*at times.*]†
19 58 21	−27 37,3	7·5	Cape Obs.: *fine ruby coloured. Two Obs.*
20 3 27	−14 40,8	var.	*R* Capricorni. Hind: *reddish.*
20 8 55	−21 44,7	6	Hist. Cél. p. 174: *red.* Cape Obs.: *this is perhaps the finest of my ruby stars.*
20 19 0	+ 9 36,3	8·5	Lamont Z. 265: *red.*
20 19 23	−28 43,1	8	Conn. d. T.: *red.* Cape Obs.: *fine ruby coloured star.*
20 50 40	+15 42,9	8	Lamont Z. 204: *red.*
21 9 15	+59 32,2	8	Conn. d. T. XV.: *red.* Piazzi 61: *ruby.* Argelander: *very red.*
21 11 31	−70 19,2	6	Cape Obs.: *ruby red, inclining to orange.*
21 36 54	+77 59,6	var.	*S* Cephei. Conn. d. T. XV.: *red.* Argelander: *very red.*
21 37 29	+37 22,6	8	Bessel: *red.*‡
21 39 13	+58 8,4	var.	W. Herschel's *garnet star.* Argelander:
21 39 17	— 2 51,5	6·5	Hist. Cél. p. 183: *red.* [*very red.*
21 57 38	+27 40,4	8	Cape Obs.: *very ruddy orange.*
22 7 52	+39 1,3	4·5	Argelander Abo Cat. 511: *red.*
22 17 52	+55 15,4	6·5	Argelander: *very red.*
22 52 30	−25 54,6	6	Hist. Cél. p. 181: *red.*
22 59 37	+ 9 47,4	var.	*R* Pegasi. Hind: *red.*
22 59 57	+ 8 39,2	5·5	Conn. d. T. XV.: *red.*
23 11 16	+48 15,0	5·5	Argelander: *red.*
23 23 31	+ 0 6,4	8	Bond p. 107: *red.*
23 25 30	+23 4,4	8	Lamont Z. 223: *red.*
23 39 14	+ 2 42,6	6	T. Mayer, Piazzi etc.: *sub-ruby.*
23 45 37	74 45,1	6·5	Radcliffe Vol. XIX.: *orange.*
23 49 55	−27 24,2	5·5	Hist. Cél. p. 570: *red.*
23 51 19	+50 36,5	var.	*R* Cassiopeæ. Pogson Radcliffe XV. p. 294: *vividly red.* Auwers A. N. 1239: *bright red.*
23 54 9	+59 34,6	6	Argelander: *red. A small bluish star following* 7s55 *on same parallel.*

* Omitted by Schjellerup. In June, 1865, we saw it repeatedly as an orange star, flushed with intense crimson. It follows 12 Aquilæ by 2′ 43″, 2′ 5″ north of the parallel. Mr. Knott believes it slightly variable.

† We are indebted to Mr. Knott for pointing out Schjellerup's omission of this star.

‡ In September, 1865, Mr. Slack requested Mr. Knott's attention to the colour of this star, and he reported that on the 15th it was a fine coppery or orange red. On another night, at intervals, it was finely flushed with pale carmine, which was often seen by Mr. Slack.

HIGHLAND INSECTS.

BY E. C. RYE.

The English Entomologist, confining himself for the most part to the productions of his native land, is at a great disadvantage, as regards mere variety and quantity of material, compared with continental workers; the late Dr. Schaum, when on a visit to this country, having indeed expressed astonishment that there should be *any* entomologists here, as there appeared such a "plentiful lack" of objects for investigation. Our insular position is, of course, in a great measure the reason of this comparative dearth of species; but, *en revanche*, it has the advantage of imposing upon our study a definite limit; and no one who has perused the works on the Atlantic fauna by our talented countryman, Mr. T. V. Wollaston, can deny the charm of working at island groups.

There are, however, more things in the British isles than are dreamed of in our philosophy, especially in the way of insects, and notably in the order *Coleoptera*, or beetles; and, strangely enough, it is from the more boreal parts of Great Britain that novelties are to be expected. The remote nooks and corners of the north are necessarily less investigated than the more easily accessible southern hunting-grounds; but the superficial observer would be inclined not to attach much weight to this point, as he would argue (and with apparent reason) that insects are most plentiful in the southern counties, and get gradually scarcer towards the midland and northern districts. Nevertheless, there are many parts of the south and west where beetles never abound, and from whence nothing entomologically good ever comes; and the geological formation and universal utilization of the soil of the midland counties account, in a great measure, for their want of insect-life,—the drainings of meres, and other "improvements," having especially exterminated many rarities. But when we get beyond the borders, and reach the mountainous districts of the Scottish highlands, a new insect-life, sub-alpine, and strange to southern eyes, greets us. Nor are the individual exponents of species rare, very many occurring in great profusion, and some of the forms being of considerable and unexpected size, curious development, and attractive colours.

Some years ago the little village of Kinloch-Rannoch, on the shores of Loch Rannoch, in Perthshire, about twenty-five miles west of Killiecrankie, was discovered (entomologically) by the late Mr. Weaver, a professional collector; and, subsequently to his time, has periodically been visited by many

pilgrims (including the writer of these notes), the result being evident in the addition of many species to our fauna, some of the most startling kind. About nine miles from Kinloch, on the south side of the loch, and stretching down to its shore, is a patch of thick pine-forest, about four miles square, known as the Black Wood, on account of the dark colour of the trees, some of which are of great age and size, being indeed occasionally so large, as to require the outstretched arms of two men to span their trunks. This forest must once have extended beyond the village of Camachgouran (*prononçez* "Camhouran," Gaëlicè), as the black soil is evidently composed of comparatively recent vegetable detritus, interspersed with knotted and gnarled stumps. Behind, is a wide-spreading flat of heather, *Sphagnum*, and pools, shut in by "Cross Craig," a mountain some three thousand feet high, its feet clothed with birch trees, and its top often snowy in summer, and nearly always wrapped in mist. To the west the view is closed in by more birch-scattered hills, at the foot of which a wide, steep, and rapid burn dashes along, with alternations of wavelets flashing over white boulders, black, sullen eddies, and leaping falls. This burn takes the drainage of the mountains on the flanks of Rannoch Moor, a vague, pathless tract, reaching to misty Glencoe, and is fed notably by a streamlet from "Gray-vel" (Gaëlic for "rough," and well deserving the epithet), a mica-capped and white marble studded peak, with precipitous crevasses, higher than and behind Cross Craig. On this mountain, in mid July, with cloudless skies and unbearable heat, I have seen patches of snow, five feet deep, and more than a hundred feet long, evidently destined to remain unmelted until increased by the next winter's fall. Here, also, ptarmigan are found among the peaks, on the lichen level. It will be noticed that in this district the conditions for the production of insect-life are extremely favourable; the heat being intense while it lasts, and alternated by a period of undisturbed rest (not the undecided winters of the south, which often allow insects to come to maturity prematurely, or tempt them from their torpid condition to an unseasonable and self-destructive activity),—the supply of vegetable pabulum unlimited, and in all stages, from soundness to decay,—and the atmosphere tempered by an almost constant dampness, in itself a necessary to most insects.

The Black Wood—however it and its neighbourhood may abound in insect-life—is nevertheless no place for drawing-room entomologists. There is a road along part of its skirts, certainly, but with that one road ends all approach to civilization. Once having left it, the collector must shift for himself—knee deep in wet *Sphagnum*, stumbling over vast decayed and

moss-grown logs, crashing through underwood, leaping from boulder to boulder, wading the numerous rapid streams, and always panting up, or slipping down-hill. Unfortunately, also, the inner man will find little indigenous food to sustain the over-taxed powers. Meat is a myth; milk scant and skim; eggs are small and few; so that oatmeal alone is left as a staple. Happy he whose primitive digestion can assimilate it with comfort. The Southron stomach does *not* take to it kindly as the sole staff of life. Of course, the luxurious traveller can take potted and savoury meats, curious drinks, and other vanities with him; but the road to Camachgouran is not favourable to much luggage. Once settled in that village, where some of the hospitable Gaëls will, for a nominal consideration, and to their own great personal discomfort, cede half of a two-roomed stone shanty to the visitor, he can, when on the verge of starvation, walk his sixteen miles to Kinloch and back for dinner—a meal to be obtained, in a surprisingly good style (apart from the oatmeal antithesis), at the fishing inn there, under the needle-peak of Schehallion.

Although my notice has been chiefly directed to the *Coleoptera* at Rannoch, there are a few conspicuous species of other orders occurring there, to which brief allusion must be made. In the *Lepidoptera*, butterflies appear to be scarce; the Alpine forms, in which the continent is so rich, being represented in this country by a very meagre list. Still, such mountain species as we possess are found here, and in abundance; *Erebia Cassiope*, a sight not often vouchsafed to southern eyes, flitting gaily on the mountain sides, high up, and retreating from observation directly the sun is obscured; *Blandina* being more common, and *Davus* swarming on the lower levels. The latter species occurs plentifully on Carrington moss, near Manchester, under similar conditions. The gap between the two localities is rather wide, but the subject of geographical distribution, as regards British insects, comprises harder problems than this; a recent puzzle having been afforded by the discovery, in one of the wet ravines at the back of Wimbledon Common, of *Stenus Kiesenwetteri*, a large and conspicuous species, and which had not long before been described as new to science from specimens found in Spain.

At Rannoch, also, among the birches, occurs plentifully, at times, the handsome moth known as "The Glory of Kent" (*Endromis versicolor*), formerly only taken in the extreme southern counties. This is one of the *Bombycidæ* to which the practice of "sembling" is so fatal; a virgin female being bred and taken into the woods, where she attracts numerous males, who insist upon being caught, as it were; but by what

marvellous keenness of perception they are directed to their unseen attraction we cannot divine.

A permanent variety of the Oak-eggar moth (also easy to catch in the way indicated above), or a species closely allied to it (for it has been described as separate), is very common here on the heather, over which its large chocolate-banded male may be seen, winging his rapid flight in the hot sunshine in search of his bride—who, larger still, and of lighter hue, reposes sluggishly near her birth-place. This insect must be dear to a believer in the Darwinian theory, as it halts between the two opinions of a species and variety; its larva feeding on a different plant to that of the type form, and differing slightly, and the perfect moth also differing slightly in colour, and coming out at a different period of the year.

Another fine moth, *Petasia nubeculosa*, first discovered here as British, is found on the birch-trees, when the snow is on the ground; for insects in Alpine situations seem less affected than their southern brethren by climatic influences: as an instance of this I may remark that I have seen *Bombus lapponum* flying and working here in the cold rain at five o'clock in the morning. Concerning the *Petasia*, its original captor adhered to the statement that he was materially aided in finding the moths by certain tree-creepers, which flew from birch to birch, chattering, and directing his attention to the insects on the trunks.

Parasitic upon some of these large moths must be a large and handsomely banded species of *Metopius*, one of the *Ichneumonidæ*, which I took flying on Grayvel; probably its larva is nourished in that of the above-mentioned eggar (*Lasiocampa callunæ*), which would be sufficiently bulky to contain it. Another very large and thin black species, allied to *Pimpla*, with exceedingly long three-bladed ovipositor, was often observed by me flying round the felled trunks at the woodman's saw-pit, Dall; and it was most interesting to watch the prying ways of the creature, as it peered into holes and crannies, delicately gauging the many galleries made by the larvæ of *Longicorn* beetles, which its formidable weapon could scarcely fail to reach. A small species of *Spathius*, supposed also to be parasitic upon wood-beetles, used to occur plentifully in the wood work of my solitary bed-dining-and-drawing-room, which was riddled by *Ptinus* and *Anobium*, evidently its prey. The *Anobium* (a genus to which the well-known "Death-watch" belongs) kept me awake for some time by the frequency and persistency of its ticking, clicking call,—one beetle answering another by rapidly striking its hard mandibles against the sides of its gallery, and the result being very clear and distinct in the stillness of the night.

Of other *Hymenoptera*, our largest saw-fly, *Cimbex femorata*, and the large wood-ant, *Formica congerens*, were most conspicuous. The former, which flies sluggishly round the tops of young birches, could be taken by suddenly and violently hitting the trunk of the tree directly the insect was observed to settle on the top shoots, when it would often fall helplessly into the net; and the nests of the ants were to be seen, sometimes of huge dimensions, agglomerate masses of pine-droppings and sticks, swarming with their bellicose tenants. In these nests (not easy to examine, apart from the large size, great numbers, and sharp mandibles of their occupants, on account of their unusually copious and pungent exhalations of formic acid) lives a small species of *Tinea*—odd dwelling for a delicate moth,—also *Homalota parallela* and other myrmecophilous *Coleoptera*, and, notably, the larva of the Scotch rose-chafer, *Cetonia ænea*, a species resembling, but duller than, our common rose-beetle.

Of the *Neuroptera*, some fine species of dragon-flies were not rare, *Cordulegaster annulatus* (found also in South Devon), being perhaps the most common, with the southern *Libellula A. maculata*, and the polar *Æschna borealis*, and *Cordulia arctica*. One cannot fail to be struck with the unusual circumstance (in England) of the large size of so many of these noteworthy insects, as, comparatively, but few of the southern forms are large; or, if so, are common species.

It is, however, to the *Coleoptera* that we must look for peculiarities of structure, novelties in appearance and habit, and additions to our lists. Here the wood-feeders, but seldom seen in the metropolitan district, play a conspicuous part, owing to the great abundance of their natural food. One of the most abundant at certain times is a *Longicorn* (*Astinomus ædilis*), which could scarcely fail to attract the attention of the most inveterate non-observer, owing to the extraordinary development of its antennæ, especially in the male. The accompanying wood-cut, in which the insects are life-size, will show to what a length horns can be carried, even in our temperate clime, unused to developments of frequent occurrence in more tropical regions. The female, readily distinguished by her long ovipositor (with which of course she lays her eggs in fitting chinks of the bark), has the antennæ much shorter than the male; a difference easily seen, even in the pupa condition, inasmuch as in that of the latter sex they are carried round in a complete circle, and again curved towards the front, whereas, in the female pupa (figured in the cut) each antenna is only just long enough to form a circle. The larvæ, which, like those of all wood-feeding insects, live for a long time in that condition, eat broad galleries on the surface of the solid

wood of the pine, beneath the bark, passing the winter in nests formed of chewed fibre, and eventually turning into pupa within a similar rampart. They seem to assume the perfect condition late in the summer or beginning of autumn, hybernating in their cell until the first hot days of the spring, when they gnaw a way to outer light with their powerful mandibles through the pine bark, which often looks as if it had served as a target for pistol practice, owing to the number, size, and neatly-cut edges of these escape holes.

Although lignivorous by nature, the males of this curious insect are excessively pugnacious; two of them settling on a tree-trunk being almost sure to fight, so that it becomes any-

thing but easy to find specimens with their fragile appendages quite perfect. It is a fine sight to the untravelled coleopterist to see a male of this exotic-looking creature flying across a glade of the forest, with his long antennæ streaming behind like the pennants of a ship. The inhabitants of the village are quite familiar with the *Astinomus*, on account of its frequenting the wood-huts, timber-cutting yards, and even the door-posts of the shanties, usually settling and gravely walking about with its horns extended laterally like an open pair of compasses, from which habit, indeed, it derives its fanciful specific name of "Ædile," as if a surveyor of buildings.

It appears to be common in Sweden, where, from its wood-frequenting habits, it is called "timberman" by the country-people, according to Linnæus; and it is exceedingly curious that several of the dwellers in Camachgouran also call it by the very same name. The insect is not known to be found in any other part of Great Britain (save accidentally; as, for instance, when a live specimen—a very Triton among the minnows of London beetles—was found in the courtyard of the British Museum, whither it had been conveyed under the bark of a stout larch pole, brought with others for scaffolding); so that the coincidence of name is very curious, for I imagine that the works of the learned Swede have not yet become household words amongst an isolated community whose sole literary wealth (*crede experto*) consisted of a Gaëlic Bible and a copy of Bunyan's "Pilgrim's Progress" (original edition).

It should be observed, however, that the parallel between the Swedish and Highland fauna is so marked that the student derives great assistance, when working in this district, from the works of Gyllenhal and Thomson; a clue to many of the species recorded by those authors, and already recognized as British, though very rare, being afforded by their notes as to habits and times of appearance, which also assist in the discovery of species new to our lists.

Another common insect at Rannoch, *Trichius fasciatus*, a *Lamellicorn* allied to the rose-beetle, is interesting, not only on account of its excessive rarity elsewhere, but also through its mimetic analogy to the common humble-bees, *Bombus muscorum* and *B. lapponum*, found in its company. It is bright yellow, with interrupted velvety black bands on the elytra, and covered with dense long yellow downy hairs, and delights to settle on thistle flowers; being, indeed, known to the villagers as the "bee-beetle." This unwonted appreciation by common people of the peculiarities of animals usually so despised as insects, is doubtless owing to their familiarity with collectors, and is possibly tinged with the suspicion of attachment of a pecuniary value, as the first visitants to Rannoch were dealers, who obtained a large price in London for insects then considered of great rarity, and therefore could afford to employ all the "young barbarians" to collect these really common things for "bawbees." Another conspicuous beetle, *Lamia textor* (which derives its specific name from a recorded habit of weaving osier-leaves together, after the manner of a tailor-bird, as a nidus) was formerly common here, but has been nearly exterminated by the "penny a-piece" system of collecting, the insect being easily seen on the willow-trees through its large size, cumbrous build, and deep black colour. It occurs also near Bristol. Very different from this is the deli-

cate, flattened, beautifully reticulated, bright red *Dictyopterus Aurora*, first discovered here, and not as yet found elsewhere in Britain, where it has long been considered as one of the arcana of science. It is very plentiful among rotten pine-chips under logs, accompanied by its larva, which much resembles that of the glow-worm, and, delicate as it is, is voracious enough, for I found one feeding on the carcase of a deceased "Shard-born" beetle (*Geotrupes*): the perfect insect may also be seen flying feebly, towards evening, in the depth of the forest. Its foreign brethren delight in settling on flowers; but we have only another species here, *D. minutus*, found very rarely in the south, mostly in rotten wood.

In consequence of the prevalence of fungoid growth under the decaying bark of felled trees and stumps, the family of *Anisotomidæ* is well represented in the Black Wood by considerable numbers of *Liodes* and *Agathidium*, the species of which much affect such food. Three of our four species of the former genus (one of them occurring here only) are indeed to be taken in considerable numbers, gregariously haunting the black powdery residuum of certain fungoid excrescences on old bare pine stumps, in which they nestle, covering themselves as a sparrow does with road dust when water is not to be had. They are very little creatures, and, like the *Agathidia*, roll themselves up into balls, drop to the ground, and "scuttle" off when alarmed by the approach of the collector's fingers.

The *Agathidia* especially frequent a small dry, pink, puffy ball, growing on pine logs, and also damp, white layers of fungus under bark. Although small, they are of great interest, owing to their peculiarities of structure, not the least of which is the diversity in the number of joints of the tarsi between the two sexes. One species, *A. Rhinoceros* (Sharp), recently found here, and apparently new to science, is conspicuous from the great development of a sharp curved horn springing out of the left mandible of the full-grown males. In small examples of that sex the horn is much reduced, sometimes even entirely vanishing; and this reduction or absence of a strong sexual development is often found in the *Coleoptera*, where the most favourable conditions are required in many instances to produce the perfection of the type form, and especially in wood-feeding insects. So great, indeed, is the disparity frequently between the two extreme phases, that authors have been tempted to describe them as specifically distinct. The common stag-beetle exhibits a good instance of the possibility of increase of the sexual distinction of size of mandibles under favourable circumstances, in its earlier stages; as small male specimens often occur with very stunted jaws, when reared from willow, or stinted in proper food during the larval condi-

tion; whilst a male from a full-fed oak-bred larva is of great bulk, and bears huge branching dentate mandibles. It is not, however, only the mandibles that are subject to this variation; all sexual developments, such as cornuted processes on head or thorax, swelling of hind femora, dilatation of the head or front tarsi, spining and curving of the hinder tibiæ, etc., come under the same law.

A very marked instance of a frequently observed habit of insects—viz., that of their frequenting places similar in colour to themselves, was constantly forced upon my eye at Rannoch by *Rhagium indagator*, a Longicorn beetle apparently peculiar to this part of our country, and belonging to a genus very destructive to timber, the fat, flat-headed larvæ swarming under pine-bark in all directions, and committing great havoc. This insect is of a mottled grey colour, strikingly similar to the lichen-covered bark of the larch, on which tree (and never on the dark black pine) I constantly found it, beetle and bark being so precisely alike in hue and markings, that it was possible absolutely to sit on the log and yet not see the insect. On these logs, and under the bark, the very flat *Pytho depressus* (another species added to our catalogue from Rannoch) is occasionally to be found—a beetle which, although apparently bulky when viewed from the upper side, is most eminently adapted for slipping into the narrowest cracks. Its voracious, elongate larva, armed at the hinder apex of the upper side with two recurved hooks, for the purpose of obtaining a fulcrum, is found under bark, where it preys upon the larvæ of *Rhagium*, and other true wood-feeders.

Running about quickly, in company with *Pytho* and the fragile *Dircæa*, *Clerus formicarius*, a curiously banded and variegated species, strongly suggestive of a large exotic ant, might often be seen; its larva being of similar sub-cortical habits to that of the *Pytho*.

The freshly-cut stumps of fir-trees, fragrant with exuding turpentine, act as splendid traps for many beetles, *Astinomus* often settling on them, and a flattish, dull black Longicorn allied to it, *Asemum striatum*, called "the soft timber man" by the wood-cutters, being very plentiful. Ripping the bark off these and older stumps disclosed numerous colonies of Xylophagous *Coleoptera*, with their larvæ and attendants; the species of *Hylastes* and *Hylurgus* being very abundant in deeply cut narrow channels worked in the underside of the bark, at the end of each of which the change to pupa takes place, the perfect insect drilling a neat round hole through which it escapes to the surface. Two species of *Ips* (one yellow, the other black, with red spots), and three or four of the linear *Rhizophagus*, abound also in these galleries; syco-

phants of the true wood-feeders, among which they have hitherto been considered to rank (as far as selection of food goes), until M. Perris, a distinguished French entomologist, pointed out their true relations with regard to the *Xylophaga*. From his observations (which I have been enabled to corroborate in a great measure) it appears that the species of *Ips* and *Rhizophagus* enter the holes made in the fir-trees (either in chinks of the bark, where there is the thinnest space between the inner and outer coatings, or, in the case of felled stumps, at the junction of the bark and wood) by the *Hylastes*, and lay their eggs in the galleries made by the latter, on whose larvæ their larvæ feed. M. Perris has observed the larvæ of the common *R. depressus* with half their bodies plunged into the larvæ or pupæ of *Hylesinus* or *Hylastes*, devouring them; and I have myself seen the same species half immersed in a sickly specimen of a perfect *Hylurgus piniperda*.*

At the junction of the bark and solid wood in freshly-cut stumps, the female of *Pissodes pini*, a large and very prettily marked northern species of weevil, may be constantly seen, laboriously drilling round holes with its rostrum, in which to deposit eggs. Its fat, full-grown larva, or the pupa in a gnawed out cell, may often be found near the ground, to which it has eaten its way under the bark; where also its ally, the still larger *Hylobius abietis*—a clumsy, dull black, delicately yellow marked *Curculio*, of very clinging habits as to its tarsi—undergoes its changes, and may be found copiously. The latter insect has been imported in Scotch timber (in the larval state) to the south, where it is not uncommon.

These species, though constantly wood-feeders, exhibit a great difference in structure to certain other tree-frequenters; their heavy bulk being strongly contrasted by the thin, flat, elegant, long-limbed, *Dendrophagus crenatus*, a very rare sub-cortical species, which I found coursing rapidly, towards evening, over a bare stump; and by the cylindrical *Xyloterus lineatus*, which undergoes its changes deep in the solid wood, drilling a small, neat shot-hole through to the surface at right-angles from the centre, and lurking at the mouth of its burrow, into which it retreats backwards on the least alarm. A similar, but larger, hole is drilled in the very hardest pines by the larva of *Hylecœtus dermestoides*, which nothing but a woodman's axe can circumvent. The exceedingly flimsy material of which this curious elongate *Malaco-*

* Certain species of *Epuræa*—small flat testaceous beetles, often seen in flowers and fungi, or at the exuding sap of trees—are also attendants upon the larvæ of the small wood-feeders; one especially, *E. pusilla* (conspicuous through the arched middle tibiæ of its male), thronging the galleries. I imagine that they are attracted by the wet frass and sappy exudations caused by the operations of the *Xylophaga*.

derm is constructed causes its burrowing operations to appear the more wonderful. In the male, usually much darker than the other sex, the maxillary palpi are of great size, assuming the appearance of a fan, on account of the third joint (which is much developed) having numerous bronchial appendages.

The southern naturalist can hardly fail to be struck by the great prevalence of certain conspicuous species of *Elateridæ*, or "skip-jacks,"—a family with which he cannot make much acquaintance in his own district. Here many of them abound, and they are often of large size and bright colours, from the very rare banded and lovely *Athous undulatus* to the shining black *Elater nigrinus*, beaten off birches; the very stones on the sandy shores of the loch covering little families of the jerking *Cryptohypnus*. Their long, vermiform larvæ abound in rotten wood; and some bright shining *Cteniceri*, with strongly-serrated antennæ in the male, fly about in the hot sunshine, often settling on timber with a metallic clang. The females of these are more sedentary and much rarer, occurring under stones, etc., and having the antennæ much smaller and more simple.

Of the *Phytophaga*, so abundant in the south, perhaps the most abundant of the few species to be seen is (at its proper season, and in its right locality) a most beautiful and variable species of *Cryptocephalus* (first discovered here in Great Britain in 1865), the 10-*punctatus* of Linnæus; which, in its normal form, is clear yellow, with black spots—the male being darker and banded—and both sexes "sporting" into a deep black variety (*bothnicus*, Linn.). This elegant creature defies the net, and has to be absolutely "stalked" in its native dwarf sallow beds; it drops hopelessly into the wet moss if a shadow fall on it, and in the hot sunshine flies as readily as the common green Tiger-beetle (*Cicindela campestris*), which abounds in the hot paths. Of the latter a black form occurs, but exceedingly rarely; dark forms, also, are to be found of many bright insects (a circumstance often observed in marshy places), so glistening and coppery a species as *Anchomenus ericeti* being here taken of a dull, deep black colour.

Want of space prevents me from entering upon the numerous fungus-feeders abounding here, from the gregarious and minute species of *Cis* to the large Cassidiform *Thymalus*—also found in the New Forest; or upon the many Coprophagous Lamellicorns, or the very numerous species of *Brachelytra* or *Staphylinidæ* (of which Scotland is the metropolis), from the lustrous but rapacious bandit *Quædius lævigatus* under bark (whose crooked yellow pupæ are often to be seen) to the many *Tachini*, living *in stercore*—insects of an apparently puzzling uniformity, but a close observation of whose diversely

sculptured anal plates has resulted already in the addition of two species from Scotland new to us. It is in the *Brachelytra* that the most numerous novelties have been, and will for some time continue to be, found. But a few words must be given to the beetles found upon the absolute mountain-tops and sides, which are of different habits and forms to those on the lower levels. On the topmost peaks, among the mist, the rare *Miscodera arctica*, a huge *Dyschirius* in show, occurs under stones; where, also, *Otiorhynchus maurus* (oftener dead and fragmentary than alive) may be seen; and the Alpine *Nebria Gyllenhali* (not seldom with lurid red elytra) replaces the closely allied *N. brevicollis* of the lowlands; the common *Patrobus rufipes* being in like manner superseded by *P. septentrionis* and *P. clavipes*. Here in moss, and under mica slabs, occur *Calathus nubigena* (apparently a mountain form of the common *C. melanocephalus*), *Anthophagus alpinus* (the males with strongly-cornuted heads, and long apical joint to the antennæ), *Arpedium*, *Geodromicus*, and hosts of other *Staphylinidæ*. This pure mountain work has great charms, apart from the adjuncts of scenery and the bracing results of the toil; for the species found are of strange aspect, the chances numerous of obtaining novelties or observing unrecorded facts, and the problems of arrested development (exemplified by apterous conditions, short elytra, etc.) and mutation of species appear to be undergoing solution under one's eyes.

In a paper of this limited length it is, of course, impossible to note more than the general features and most salient forms of so extensive a subject as the entomological productions of a rich district; indeed, a mere enumeration of all the new and rare species that have been found at or near Rannoch alone would occupy too much space—in spite of the fact that only two orders, the *Lepidoptera* and *Coleoptera*, have been as yet worked with any energy. Enough has been done to show that for many years the English naturalist need not travel out of his own country to find novelties.

PLANS FOR IMPROVING LONDON.

The present year, A.D. 1866, marks a period of exactly two centuries since the great fire of London, an event at that time naturally considered as a great national calamity, but which might have tended to a great national good, if firmness and sound common sense had been allowed to prevail over prejudices and self-interests. The little mind and short-sightedness were unfortunately as common in those days as at the present time, and Sir Christopher Wren's noble plan for rebuilding the destroyed portions of the metropolis was rejected in the same obstinate manner as the proposed principal lines of our railways were in our own days, when first brought before the public. In 1766, exactly one hundred years after London's great conflagration, John Gwynn published his *London and Westminster Improved*, illustrated by some admirable plans, in which more than one hundred improvements are mapped and described. In the present year, after the lapse of another century, the Engineer and Surveyor to the Commissioners of Sewers for the City of London brings forward a most able and elaborate report on *The Traffic and Improvements in the Public Ways of the City of London.*

It may, perhaps, be interesting to take a glance at these centenary productions. John Gwynn was a bold man in his way; expense to him was a matter not to be thought of. The title of his work states that his illustrated plans were prefixed by "A Discourse on Publick Magnificence," and in 132 pages of letter-press he contended for his several suggested improvements with all the ardour and ability of the Préfet Haussmann. Gwynn proposed two royal palaces—one in Hyde Park, with a circular road of one mile in circumference to enclose it, and another to fill up the space from the Green Park to St. James's Street, with one end towards Piccadilly and the other on the site of the present St. James's Palace. The Houses of Parliament he proposed to rebuild; and not having the fear of the mediævalists before his eyes, he desired to make a clear sweep of Westminster Hall, in order that the site might be raised to a proper and higher level above the river. And although at the first sight we may be astounded at so audacious a proposal, yet, in so large an outlay as there has necessarily been in the construction of the Palace of Westminster, the additional amount in raising the ground floor—the *piano nobile*—of the whole structure some fifteen feet, and rebuilding Westminster Hall on its present site, raising the roof, and making every portion of it a strict restoration of the present venerable pile, would have been at a cost justified by the national importance

of the structure, and adding immensely to the grandeur and dignity of what ought to have been the most magnificent work of architecture in the metropolis.

Gwynn's veneration for Westminster Abbey stayed his hand of demolition in that sacred quarter; but the Dean and Chapter had no doubt smiled at his suggestion, that "*an elegant light Gothic dome*" be raised from the nave of the Church, and "the whole inside of the building *painted of an uniform clean stone colour*, in the manner that St. Paul's Church is, it would then become a most beautiful pile, and be deservedly esteemed one of the finest things of the kind perhaps in Europe." St. Paul's also was to come in for a share of suggested improvement, by the lead-work of the cupola "*being painted in stone colour.*"

We may smile at these well-intentioned suggestions, but in Gwynn's long list of improvements there are many which are entitled to great praise, and some have been since acted upon. We will just run through some of the most salient.

"Bedford Row is opened into Holborn, and the line continued to Lincoln's Inn Gardens."

"St. George's, Bloomsbury, is detached and disencumbered from the buildings, and streets opened north and south."

"An opening sixty feet wide is made through Leicester Square from Piccadilly, and continued into Long Acre. The west end of Queen Street, called the *Devil's Gap*, is here opened equal to the breadth of that street obliquely from Long Acre."

The opening into Leicester Square from Piccadilly has been done; the "Devil's Gap," it is feared, still remains.

"From the opening at the north-east corner of Leicester Fields before-mentioned, a street of fifty feet in width, making an acute angle with Long Acre, is carried through St. Martin's Lane into New Street." This improvement has also been effected, although not quite in the order described. Garrick Street is even better than Gwynn's line of street, and the Club House on the south side presents a striking façade.

"The Haymarket is continued to St. James's Park, where a triumphal arch may be erected as a termimation to the view."

"A spacious opening is made at Spring Gardens from the Park, and continued to Charing Cross, opposite the Strand."

"A direct line from Northumberland House is drawn to Whitehall, and two considerable streets are formed which run down to the Thames, one of them directly fronts the Admiralty." It is to be hoped that the proposal for an opening from Charing Cross, which has of late been seriously entertained,

may still be accomplished, and that even the ducal Northumberland Palazzo may not be allowed "to stop the way."

"A new bridge is designed from the Savoy across the river Thames."

By referring to the plan it will be seen that three radiating straight lines of streets diverge from a crescent at the foot of the bridge, the centre one leading to Bow Street and Long Acre, the westward one to Southampton Street in the Strand, and that to the east to Catherine Street in the Strand. The situation thus marked out for St. George's Bridge by Gwynn one hundred years ago, has, in our times, been very nearly adopted in the construction of Waterloo Bridge by a public company, but unfortunately without the radiating streets Gwynn laid down. That this bridge, an important entrance to London, should be allowed to continue a toll bridge is most degrading to a great nation; indeed it ought to have been a national work in the first instance, and suitable approaches made at both ends of it, with buildings of character and importance, instead of the mean and wretched tenements in Wellington Street, and the abominable common lodging-houses on the Surrey side. With the successful completion of Somerset House, Wellington Street ought to be rendered worthy of the name it bears and of the bridge it leads to.

"Carey Street is continued into Vere Street, and widened at the end next Chancery Lane." This alteration has been effected, and there is hardly any part of the metropolis which of late years has been so much improved as the south end of Chancery Lane. The widening of Carey Street, the new Union Bank, and other commercial buildings, have all tended to make this an important thoroughfare; but with all the large outlay with which this has been effected by the City of London, the north approach from Holborn is only of sufficient width for *one* carriage, and the corner house was allowed to be rebuilt upon the old site only a few years since.

The above are only a few of the numerous improvements in Gwynn's first and second plates. The third map relates to the City proper, in which many alterations are suggested about the Mansion House, the Royal Exchange, and Moorfields, some of which have been adopted entirely, and others with modifications; but as it would occupy too much space in this paper to describe them fully, we will pass on to the present century, and take a rapid view of what has been done since Gwynn produced his *London and Westminster Improved*. The Houses of Parliament have been rebuilt, Victoria Street, Westminster, is in the course of completion, Buckingham Palace has been rebuilt, the new and extensive quarter of Belgravia formed upon swamps and open fields where snipes have been shot in the memory of living Londoners.

Kensington is now united to the metropolis by rows of splendid terraces overlooking Hyde Park, and has extended to the south, forming a new quarter, which will probably ere long be devoted to the fine arts. On the other side of Hyde Park, the humble Bayswater, and the culprits' spot of doom, now stand forth a district of palaces and villas, known as Tyburnia. Marylebone fields have been converted into a charming park, where the horticulturist spreads forth his treasures, and the professors of zoology find a home for natural history. The master-hand that originated the park also designed a noble street from Portland Place to Pall Mall, as well as Trafalgar Square, and widening the Strand. The Victoria Park and Battersea Park are also new creations; the latter, one of the happiest and most successful works of the able hand now attached to the Woods and Forests' department.

In the City of London a new street has been formed from Finsbury to the Mansion House, another from the Mansion House to London Bridge, and a third from London Bridge to St. Paul's; besides sundry widenings, lopping off of corners, setting back houses, and obtaining additional width to streets. These, for the most part, have been well done. A great portion of them were due to the energy of Mr. Lambert Jones, an influential member of the Corporation. He was for a time master of the situation; but he unfortunately was too careful of the City purse, and instead of forming a bold plan in making a good line of thoroughfare from Guildhall to the Post Office, made so tortuous a line, as to occasion the remark, that "Crooked Lane (close by London Bridge) was removed to Gresham Street." London Bridge and Westminster Bridge have both been rebuilt, and the Southwark, Waterloo, Hungerford, Lambeth, and Vauxhall bridges are all new erections. A noble street has been formed on the Surrey side, leading from London Bridge to Blackfriars; there are several fine piles of warehouses erected in this important thoroughfare—one in particular, on the south side, belonging to the Hop Planters' Company, which has a *portone* worthy of the old Italian architects. With this rapid notice of works *de facto*, we will take Mr. Haywood's plan, and see what he has *in petto* for us, premising that his report being an official one, connected with his appointment under the Corporation of London, is principally confined to the City proper. "But, in order," says Mr. Haywood, "to take the broad and comprehensive view which the subject demands, I must refer to the whole metropolis, for I shall be enabled to show that a large portion of its inhabitants have the most direct interest in the City of London, going to and from it daily, spending within its limits the largest portion of their active life, earning therein their livelihood, and forming the bulk of the traffic which encumbers its streets.

"The population of the metropolis was, in 1801, 958,863; in 1861, 2,803,989—thus having trebled itself in sixty years. In 1865 the population was computed to be, in round numbers, *three millions;* therefore, in forty years hence it may be expected to be *six millions;* and it is for the wants of this future, as well as for those of the present community, in respect of highways, that provision must now be made."

Mr. Haywood introduces in his report several most useful and valuable tables, showing the vehicular and pedestrian traffic, the areas of various thoroughfares, the number of persons entering into the City on certain days, and proves incontestably how enormous the amount of the to-and-fro population is to the sleeping population. The following paragraph will no doubt astonish some of our old, retired City tradesmen of twenty-five years ago:—"As the traffic has increased since 1860, it may be computed that there now pass into the City of London daily three quarters of a million of human beings, and that the same number pass out at night, leaving but its residential, or sleeping population of 113,387; and this vast daily influx is equal to *one-fourth part of the whole metropolitan population.*"

"This enormous amount of in-comers and out-goers comprises all classes of society, from the highest to the very humblest in the social scale. Thus, there are 68 Members of Parliament who have offices within the City, and of that large class who are directors of the commercial undertakings which must have a home in the commercial centre, there are 56 Peers of the realm, 132 Members of Parliament, and altogether as many as 589 titled and distinguished personages, whose directorial duties bring them frequently within its precincts."

Of the vehicular traffic, it would appear, that during twelve hours in June, 1865, 19,405 vehicles passed over London Bridge, and 11,972 through Fleet Street by Temple Bar, being about fifty-one per cent. above the traffic in 1850.

After an able exposition of the immense and daily-increasing amount of civic traffic, both pedestrian and vehicular, already producing the greatest inconvenience from the crowded state of the streets, Mr. Haywood boldly states, "*There is but one complete remedy for this, which is the formation of a new bridge, or a tunnel, with suitable approaches, lower down the river than London Bridge.*"

This is certainly a startling proposition at the first view, and Mr. Haywood really exceeds his rival, Mr. Gwynn, in the boldness of his projects; but a little calm consideration of the following paragraph may convince us that Mr. Haywood's boldness is the result of sound judgment. He says:—

"I am aware of the great interests which would be interfered with by the construction of this bridge; I am aware of the large sum of money which would be required, although I believe that the cost is exaggerated in the minds of most; but whatever the interests may be, and whatever the cost may be, sooner or later a bridge or a tunnel must be built lower down the river. Nothing else will effectually relieve London Bridge at the present day, and nothing else will satisfy the requirements of the vast population which will exist east of London Bridge; and it is to be hoped that this necessity will be boldly faced at once, and not be postponed until the period when it will cost double the outlay now needed, however great that outlay may be."

This is followed up by some very sensible remarks as to the width of streets and bridges, showing clearly that the author of the report is not led away by projects of grandeur or magnificence, but that the useful is what he has always in view. The following is the extract from the report to which we allude: —"It is, however, fundamentally an error to make streets and bridges of very great width; large streets are more costly; they are also in one respect inconvenient; they lead to concentration of traffic, and if stopped or impeded (as at times they must be) the public inconvenience is very great. *Diffusion*, and not *concentration* of traffic should be the object in devising the thoroughfares of large towns. Alternative lines give the most convenience; and, as a principle, it may be said that it is far better to have two bridges, each of fifty feet in width, than one of 100 feet in width, even if the cost were greater for the two than the one."

Our space will not permit us to cull any more of the wise saws and interesting statements abounding in this able report. We cannot, however, conclude without a view of the map in which Mr. Haywood lays dows a projected new street leading from the east end of the Holborn viaduct to a point in Whitechapel, High Street, where the Metropolitan Board of Works propose a continuation of it to the Docks. This fine line of thoroughfare takes a gentle curve to the northward; it passes close in the rear of Christ's Hospital and crosses Aldersgate Street, Wood Street, Aldermanbury, Coleman Street, and Moorgate Street, Broad Street, and Bishopsgate Street, and debouches at Whitechapel, as above shown. This would afford an immense relief to the traffic of Newgate Street, Cheapside, the Poultry, Cornhill, Leadenhall Street, and Aldgate.

The curved line of the street is so gentle that it will scarcely be perceived in so long a distance; indeed, in some cases, such as the High Street, Oxford, curved lines are more

picturesque and beautiful than straight ones. We cannot conclude our notice upon this able report without one more quotation from it, and bestowing our sincerest congratulations to the Commissioners of Sewers for the City of London upon possessing so accomplished and efficient an officer in the Surveyor and Engineer:—

"That looking to the future as well as the present necessities, and having regard to the fact that the cost of present improvements will probably be in a degree cast upon a future generation, they should be planned and carried out upon the broadest and most comprehensive scale, that no obstacle should be allowed to interfere with this principle; and that such course is true economy.

"It should be held in mind that where the need for public improvements arises from the increase in the numbers, business, and wealth of the population, it may generally be inferred that the population is able to pay for them."

THE PLANET SATURN.

(CONTINUED.)

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

In our last No. attention was drawn to the insufficiency of the evidence by which the period of rotation of the ring has hitherto been considered to be determined. It will be at once understood, that no idea is entertained of throwing doubt upon the fact of rotation. The reader is in possession of the means of showing the insufficiency of the objections of Schröter, Schumacher, and Schwabe; and if such a motion is not a necessary condition of equilibrium, it would be entirely beyond the power of the writer to show it to be otherwise.* What has been said amounts merely to this, that the period must still be considered as unascertained, so far as observation is concerned: even its theoretical value is rather uncertain, for Secchi has given 14·238 hours as the period of a satellite revolving a little within the external ring, A. One thing is evident, that it must differ, theoreti-

* There are some curious observations by De-Vico which are worthy of mention. On several successive nights in 1840, an extremely minute point of light, like one of the smallest satellites, was seen in the E. ansa, immovably attached to the edge of the ring (B), then widely open. A similarly-situated pretty bright point was again seen 1842, Oct 17, Ball's alone among the divisions being visible, but that very distinct. It is difficult to explain this in connection with rotation.

cally, according to the 3rd law of Kepler, for every point in the breadth of the ring—and that it must differ, practically, for every zone of the ring that has a separate existence; the width of each zone being probably determined by the relative proportion of the forces of cohesion and gravity, or, in other words, by its power of resisting the strain to which it is subjected by a rotation, the uniformity of which must necessarily be too rapid for its outer, too slow for its inner edge. From this cause Laplace perceived that the ring must be multiple; and Pierce considers that it may be divided into at least twenty annuli, each having a period of its own.

The rotation of the dark ring, C, seems to be shown by the varying colour of its ansæ; but nothing definite has been ascertained with respect to it.

There are observations which seem to indicate that the general plane of the rings is not always coincident with that of the equator of the globe. We have already mentioned a want of parallelism between the belts and ring observed by ♄ and De-Vico (INTELLECTUAL OBSERVER, ix. 254). The same was noticed by Schwabe, 1828–29–30, when the ring-shadow and the belts converged W., though not always equally.—1833, Dec., he saw the elliptic outline of the planet very obviously inclined to the ring.—1848, Sept. 30, shadow not exactly in direction of equatorial belt.—Schmidt, the same on several nights, Sept., proved by divided object-glass. 14, belts inclined to line of satellites.—1862, May 22, Secchi proved by measurement that the black shadow was not parallel to the belts. Nothing more, of course, could be inferred from a single observation of this kind, than the probability of an oblique current in the atmosphere of the ball; but a little consideration will show, that if the obliquity is maintained through a series of observations, when rotation has brought all parts of the ball successively under the eye, it can only be explained by a temporary deviation of the ring-plane from that of the equator—a very curious feature, if it can be established.

Another deviation from symmetry is implied in certain appearances, which, if not illusory, may be ascribed either to unequal curvature in the two hemispheres, or to an anomalous position of the ring-plane, not dividing the ball exactly in half. This construction might be put upon the observations of ♄ and Gruithuisen, about to be cited under the head of refraction; and the following may be added: Valz at the disappearance in 1833 saw N. hemisphere much more considerable than S.—1848, July 11, Bond II. saw ball most flattened at N. Pole.—Aug. 29, it seems not symmetrical; flattest at N. Pole: Bond I.—Sept. 9, Busch and Luther thought centre of ball somewhat S. of that of ring.—Oct. 10, ring and shadow to

the eye nearer S. than N., Bond II: *by micrometer*, 8″·5 and 9″·4.—1852, Sept. 29, Bond II. found the ball projecting somewhat more over the edge of the ring in front (S.) than behind it. Dec. 1, distance between intersections of outer edge of A with ball greater to the eye S. than N.: *by micrometer*, 10″·68 and 9″·11 (exceedingly fine definition). It is conceivable that the two hemispheres may be unequal in density; and the singular irregularity in terrestrial attraction which has recently been discovered round Moscow furnishes an analogy which might possibly find its counterpart in Saturn on a much larger scale, so as to dissociate the centre of gravity from the centre of figure of the ball; but unfortunately such an explanation would only be applicable if the deviation were always in the same direction.

Whether the whole ring-system may be encompassed by any perceptible amount of atmosphere is an enquiry worthy of attention. ♄ considered it probable, not only because even the smallest satellites appeared distinctly protuberant on either side of the thin ring-line, but because in June, 1807, when the ring crossed the S. hemisphere so as to leave only a segment of 1″·3 or 1″·4 in breadth visible, that portion seemed curved or bulged outwards, while the opposite N. pole retained it usual flattened appearance. This observation, which was frequently repeated, was confirmed by his son, as well as by Professor Wilson with another telescope. A refraction of ⅓″ would, he thought, be adequate to the effect. The same appearance was remarked by Gruithuisen, 1817, and in the same direction. It may be questioned, however, whether this is anything more than an optical deception, the counterpart of the quadrilateral figure of the ball. Were it a reality, its effect would increase with the decrease of the outstanding segment, till the last visible portion of the latter would exhibit an unmistakable amount of distorted elevation. Nothing of the kind, however, is on record. On the contrary, Bond II. noted, 1853, Dec. 15, that the N. pole was invisible, when the S. limb just touched the outer edge of A: circumstances under which refraction round either ball or ring would surely have made itself known.

The idea, however, of an atmosphere is not without support from evidence of another nature. 1828, Jan. 22, Kater was led to the same conclusion, by noticing that during an observation of several hours, in a perfectly favourable evening, he could find no trace of the subdivisions upon A which had struck him so much on a former occasion.

Other phenomena also may be referred to the presence of such an envelope. But before describing them we must obtain some idea of the cause of the multiform aspect of the ring

where it crosses the globe. Various cases of projection and degrees of illumination arise from the changing, and sometimes opposite positions of the sun and earth with regard to the ring-plane. When this stands nearly edgeways to both, the ring and its shadow may be alike invisible (1848, Dawes, Sept. 1, 13. Schm: Sept. 6, 14, 17, 18). If the sun and earth are both on the same side, and equally elevated, the ring will hide the shadow, but may be itself perceptible as a grey stripe from the duskiness of C, and the greater part of B, to which possibly the enfeebling of the solar light through the "horizontal misty air" of its own atmosphere may contribute (see Schwabe's observation *infra* of the progressively fading ring, 1845). If the sun is higher than the earth above the ring-plane, the shadow will be visible beneath it, and A and B will be relieved upon the ball between two unequally dark borders,* C on the one side, and the true shadow on the other—a beautiful sight. If the earth be the higher, the shadow of A and B will be lost sight of behind C, the nearer part of which it ought to render deeper in shade. I do not know that it has been seen to do so; but in this position Dawes failed to distinguish the shadow of C from C itself across the ball. If the sun and earth are on opposite sides of the plane, and each sufficiently removed from it, the ring and its shadow will come out as two dark lines crossing the ball, with an extremely narrow bright streak, a portion of the ball's surface, between them. This extremely minute object, though repeatedly seen,† has not been always visible when we might have expected it; the difference might arise from a change in the position of the plane of C (we may here remark, by the way, that if C were materially thicker than the other rings, it is scarcely conceivable that this streak of light should be ever visible); or it might be referred to the presence of an atmosphere; some possible indications of which we shall now be better able to appreciate.

During the decrease of the ring in 1845, Schwabe found it gradually diminishing in reflective power, till from being in July always brighter than the ball, it had become equal in September, and by Oct. 11, a trifle fainter, and at the same time more of an orange-grey. This went on increasing, and he could only exceptionally note the colours alike, though the ring was always the fainter. After Nov. 21, it was always much the darker, especially on the W. side.—1848. June 30,

* 1851, Oct. 26. Dawes saw both equally black, but in consequence of their falling on very unequally reflective parts of the ball.

† Intellectual Observer, ix. 381, where it is erroneously stated never to be mentioned by the American observers. See Bond I., 1848, Nov. 22. To the instances of visibility there given, should be added 1861, Dec. 4, Jacob.—1862, May 13, Talmage.

Aug. 9, Dawes found the unenlightened ansæ with 6¼in. not quite invisible on the sky, of a deep coppery tinge like the eclipsed moon. On many other evenings the visibility of the dark side is noted, just as by Bond and others; but Dawes differs from them in thinking that what was seen was not the edge, or light through openings, but the whole surface feebly illuminated, more probably by atmospheric twilight than by reflection from the ball (an idea which had occurred to Ⅎ). The ring across the globe appeared less dark than its shadow when it was possible to distinguish them; a difference which was also noted by Schmidt, Sept. 19, with the addition that these details were much less distinct towards W. limb. 20, 21, nearly the same. Oct. 12, while ring invisible, he and Brunnow at Bilk saw shadow plainer and sharper E. Dec. 3, Schm. the same again.

During this season Bond II. found, July 10, the band across the ball not quite black; 18, it was darkest near *f* limb, B. I. II. 21, ditto, B. II. Aug. 29, growing less dark, B. I. II. [as the light fell more horizontally upon it]. Sept. 18, Oct. 6, not black, B. II. Nov. 13, perhaps a twilight illumination upon it, B. I. 22, not by any means black, B. II.—1849, Jan. 26, Schm. saw the re-appearing shadow faint, and in places very indistinct.—1852, Nov. Lassell at Malta saw on two nights the shadow not black, but like C., and not sharply defined. 1861, Nov. 8, Secchi found the ring decidedly reddish across the ball, though we were looking on the sunny side. 15, violet on ball, darker than he could have supposed possible, almost black, "truly surprising," but not well defined, whence he inferred an atmosphere. 23, much the same; the earth not till now passing to the dark side. 1862, April 25, ansæ on sky ruddy. Hence, he says, encompassed by a strong atmosphere, if there is any solid part to encompass. May 13, Birt saw shadow darker than ring on ball. Carpenter, at Greenwich, found the ring of a dirty copper colour. June 3, fancied it very faintly illuminated. 1862, May 17, when the shadow of Titan, the largest satellite, was crossing the disc,—a very interesting sight, which I was permitted to witness,—Dawes could find no trace of the shadow, which he had expected to see with 8¼ inches in beautiful air; the ring was like a very dark pencil line, but not inky black like the shadow of Titan, and there was a very faint coppery gleam, much more plainly seen on several subsequent evenings, in the place of the ansæ on either side: these appearances he was disposed to refer to refraction through a pretty dense atmosphere producing a twilight on the dark side, and diluting the shadow on the ball. About the same time Huggins saw the ansæ of a deep bluish purple,—May 20, a beautiful dark blue, scarcely

distinguishable from that of the sky.—16, to June 10, he searched in vain, like Dawes, for the shadow of the ring, which ought to have become visible in consequence of the sun's passage to the side opposite to the earth about 17.—May 17, ☽ II. considered the light of W. "of the colour of rose copper." (Edgewise that day to sun.)

The reader who has had the patience to examine and compare the mass of details which has been laid before him, in an accumulation which must have appeared more than ordinarily tedious to those not specially interested in the subject, will be disposed, we think, to view it in a two-fold light. Some part of it he will consider sufficiently intelligible on the principles of analogy and the known laws of the universe; other portions he will find so puzzling, that he would take refuge in the supposition of instrumental or personal error, did it not seem precluded by the character of the testimony. But what shall we say when we find that a number of observations which remain, are still less capable of explanation upon known principles, and at the same time are so well established by the consent of astronomers, that they cannot fairly be got rid of by any supposition of illusion? To explain them aright is most difficult; to explain them away may suit the taste of those who choose to magnify the attainments of human knowledge, but they would scarcely have escaped the censure of Aristides of old, in thus adopting a course which, however expedient, would not be just. The true philosopher, on the contrary, deems such outstanding phænomena of peculiar interest and value. They have continually recurred during the extension of physical knowledge, and have furnished invaluable tests of the truth of theories, which, but for them, might have found unchallenged but erroneous acceptance. And though those to which we are now referring do not seem weighty enough to overthrow any received hypothesis, yet they are such as, steadily kept in sight and diligently pursued, may lead to interesting investigations and valuable conclusions.

We have indulged in very little speculation as to the possible materials of the ball and rings. Their nature is indeed involved in so much mystery that the reader will not be disappointed if we enter into no lengthened discussion upon the subject. The very slight density of the globe is well known. It has been given at only 0·132251 (the earth being 1), or $\frac{1}{8}$ that of water, so that it would float high out of a terrestrial ocean large enough to give it sea-room. And if, as may be expected from analogy, its density increases towards the centre, the value already specified being the average of the whole mass, the exterior shell must be considerably lighter still, and we can hardly form an idea of solid materials suf-

ficiently attenuated to take their place on its surface. If fluid existed there in any quantity, Beer and Mädler have supposed that it would be raised up in a gigantic and permanent equatorial tide by the attraction of the ring: of this, however, there is no appearance.* Mädler observes that the planet is far brighter than accords with its distance from the sun (whence Gruithuisen had previously inferred the existence of native light); but this, from the analogy of Jupiter, would be due to the highly reflective power of the vapours suspended in its atmosphere.† The density of the ring has been valued by Bessel at $\frac{1}{11\frac{1}{2}}$ of that of Saturn. The aspect, at least of its brighter parts, is undoubtedly that of a solid, but at such a distance the mere evidence of sense is fallacious—a terrestrial thundercloud similarly situated would undoubtedly give as bright a reflection, as hard an outline, and as black a shadow. Secchi, in fact, has become convinced that the whole appendage is of a gaseous nature, and consists of opaque clouds suspended in an imperfectly transparent atmosphere, which renders itself visible in the dusky ring, and fills up Ball's division with feeble light. Theory, as has been stated, is entirely against its continuous solidity. Professor Maxwell (of Aberdeen) has investigated the question with great ability in an essay which gained the Adams Prize at Cambridge. He has shown that Laplace's result was imperfectly worked out, and that instead of concluding that the rings were irregular solids of unequal thickness, he should have inferred that since if solid and uniform their motion would be unstable and they would be destroyed, the fact that they are stable and permanent shows that they are either not uniform, or not solid. He then proves that so great a degree of irregularity as Laplace's theory would require, being equivalent to a *load* upon the ring, is not consistent with the observed structure,‡ and that therefore, though a rigid ring is not impossible, it is impossible that the rings of Saturn can be such. A continuous fluid ring would in theory suffer such perturbation as to break it up; and he therefore concludes that the rings are "composed of an indefinite number of unconnected particles, revolving round the planet with different velocities according to their respective distances," and that these are probably arranged in a series of

* B. and M. thought otherwise. They interpreted in this way, curiously enough, the aspect of ring C upon the ball, and imagined a corresponding determination of all the fluid in the ring to its inner edge, causing its more dusky light.

† 1848, Schmidt watched the gradual removal northward of the central zone, which is usually the most luminous part, till, Sept. 17, the whole of it had passed into N. latitude.

‡ Schr's 100 miles, in p. 379 of our June No. being German, should have stood as 460. Yet, had this been a real elevation, it seems that it would not have been large enough to ensure stability.

narrow rings, affected by waves of transversal displacement, as well as of condensation and rarefaction. To obtain ocular proof of the accuracy of this remarkable theory, to which so much publicity has recently been given by the ingenious and elaborate treatise of Mr. Proctor, may never perhaps be granted to us; we must not forget that even under the most favourable circumstances, we have to contend with 700 millions of miles of space! It remains to be seen what may be effected by persevering examination; hitherto it must be admitted that instead of removing, it has increased the difficulties of the subject. This will sufficiently appear from the ensuing part of our prolonged recital, in which we shall see whether any information as to the structure of the rings, or indeed of the ball, can be deduced from the appearance of their respective shadows. The reader has already met with some puzzling matter; he must now be prepared for statements still less intelligible.

So great is the variety presented to us in this marvellous planetary system, that we are again obliged to postpone our conclusion.

OCCULTATIONS.

Sept. 26, ξ Arietis, 5½ mag. 9h. 42m. to 10h. 37m., B.A.C. 755, 6 mag. 10h. 28m. to 11h. 31m.—28, γ Tauri, 4 mag. 8h. 17m. to 8h. 42m. (well worth looking for). 75 Tauri, 6 mag. 11h. 40m. to 12h. 41m.—29, 111 Tauri, 6 mag. 9h. 58m. to 10h. 43m. 117 Tauri, 6 mag. 11h. 20m. to 12h. 13m.

THE LAKE-DWELLERS OF SWITZERLAND.*

In our fifth volume we published an interesting paper by Mr. Henry Woodward, *On the Ancient Lake Habitations of Switzerland*, and illustrated it by a plate containing a series of drawings of implements and ornaments obtained from the Swiss lake explorations, and now deposited in the British Museum. We must refer our readers to that paper for general views on the subject, and for sketches of objects belonging to various dates. Our present purpose is to call attention to a very valuable and beautiful work by Dr. Ferdinand Keller and Dr. J. E. Lee. Dr. Keller is the author of a series of papers on the lake dwellings, and Dr. Lee has, with his consent,

* *The Lake-Dwellings of Switzerland, and other parts of Europe.* By Dr. Ferdinand Keller, President of the Antiquarian Society at Zurich. Translated and arranged by John Edward Lee, F.S.A., F.G.S. Author of "Isca Silurium," etc. Longmans.

rearranged and translated them, with additions and alterations made by Dr. Keller, or with his approval, so as to make the book an invaluable treasury of facts known up to the present time. The illustrations are of a very high order of merit, and occupy no less than ninety-six plates, comprehending an amazing variety of objects, elucidating the mode of life and state of art amongst a most interesting set of men during the many generations that they adopted a sort of amphibious life.

To settle with tolerable approximation to accuracy the earliest period illustrated by the relics of the lake-dwellers is a difficult task for the geologist, but to the antiquarian belong the later periods in which the influence of Roman civilization is distinctly seen. That in Switzerland, in Ireland, and in various parts of the earth, tribes should have lived surrounded by water on artificial islands, is not in itself to be wondered at. Fishing must have been a source of subsistence almost as universal as the water in which the aquatic vertebrates dwell. Hence the vicinity of rivers, lakes, and seas must have been favourable to the multiplication of the human race, and to their aggregation into communities. Nor are we astonished that the water should be turned into a means of defence. An island, whether natural or artificial, is, by its position, more or less protected from the attacks which rude savages can carry on; and a tribe of people living in a village sustained upon piles, only accessible from the mainland by a single causeway, or rude bridge, supplied with fish from the adjacent water, and never lacking the fluid most essential for quenching thirst, might be regarded as in a condition of considerable security and comfort.

The researches which Dr. Lee has now rendered accessible to English readers, seem to show that the custom of living on pile-supported villages in lakes, was by no means confined to a peculiar race distinct from the inhabitants of the adjacent land, nor limited to such times of barbarism as might have been supposed. The earliest lake-dwellers must, if we consider them to have been the parents and progenitors of the later lake-dwellers, have already started on the road to civilization. Their implements may have been rude, their wants few, and their means of supplying them small; but they must have been in a very different state from those races of savages which remain stationary or die out, as circumstances change. In the earliest lake-dwelling period, rude huts, resting on piles, and made in a rough fashion, something like the "wattle and dab" construction of Australian settlers at the present day, with clay floors, and roofs of bark, straw, and rushes, seem to have been aggregated into villages of considerable size. Fishing nets, and hooks made of boars' tusks, have been found in some

of the earliest settlements, and organic remains likewise show that the lake-dweller was a hunter as well as a fisherman, and chased the land animals as well as caught the finny tribes. Any bone containing marrow seems to have been dexterously split lengthwise, to get at what Professor Rütimeyer calls a "miserable pittance," but which the old lake-dwellers, agreeing with many moderns, may have considered a tit-bit. The work before us says: "The investigation of the bones which are found in such great numbers amongst the piles of all the lake-dwellings, has shown that, together with the remains of the beasts of the chase, those of domestic animals are met with, especially of the dog, which even in the oldest settlements is found as man's companion, and, moreover, of cows, sheep, goats, and pigs." If this was the state of things with the earliest lake-dwellers, they must have been considerably in advance of the mere hunter stage of existence; and it is, moreover, found that they were agriculturists as well as keepers of cows and other animals. A sort of scratching or tearing of the ground with tools of stags-horn, or wood, seems to have been an anticipation of ploughing, but their produce was of good quality, and considerable in amount.

Professor Heer divides the plants hitherto found in the lake dwellings into—1, cereals; 2, weeds of the corn-fields; 3, culinary vegetables; 4, fruit and berries; 5, nuts; 6, oil-producing plants; 7, aromatic plants; 8, bark and fibrous plants; 9, plants used for dying; 10, forest trees and shrubs; 11, mosses and ferns; 12, fungi for kindling fire; 13, water and marsh plants. The cereals comprehended the small-grained six-rowed barley, a small variety of wheat, a beardless compact wheat, and two kinds of millet. Masses of manure from domestic animals indicate that heaps of such materials were systematically collected. The fruits comprised crabs, apples, pears, strawberries, raspberries, cherries, plums, etc.; a cake of poppy seeds, pressed, probably for oil, was found at Robenhausen, and also carraways, which may have been a condiment. As lake-dwelling existed for many generations, the state of agriculture must have changed, and that of the earliest times may be presumed not to have comprised all the articles in the list. "The inhabitants of the lake-dwellings," do not, according to Professor Heer, "appear to have had any close connection with the people of eastern Europe, for they, at least in the bronze age, cultivated rye, with which the lake settlers must have been acquainted if there had been any extensive intercourse. On the contrary, all the cultivated plants show a connection with the countries of the Mediterranean." Thus, their agriculture seems to have come from the basin of the Mediterranean, and Professor Heer remarks concerning celts of

nephrite, found in the lake-dwellings, "The presence of what is called noble nephrite, which is only known in the east, is not more strange than the appearance of the Egyptian wheat, the Cretan cattle fly, the oil-yielding poppy, and the glass beads found at Wauwyl, which were either of Egyptian or Phenician origin. Professor Heer does not assign a very high degree of antiquity to the lake-dwellings, but thinks it probable that they extended back to one or two thousand years before the Christian era. Professor Rütimeyer, who has examined the remains of the animals that co-existed with the lake-dwellers, observes, "I cannot, however, refrain from expressing my conviction, that even the oldest lake-dwellings do not by any means exhibit to us the primitive population of our country. I must, indeed, regard them as 'autochthones,' or, at least, as very ancient inhabitants of these districts, for they possessed, as domestic animals, a number of those that undoubtedly were indigenous here, particularly the urus and the marsh swine; but the fact that from the beginning they had the sheep and the dog, the indigenous origin of which is, to say the least, highly improbable, indicates their having descended from a still earlier people. For my own part, therefore, I have little doubt of the existence at one time of a genuine primitive population throughout Europe. This appears to have been proved, as far as France is concerned, by the latest discovery at Aurignac." In another passage the Professor adds, "The discovery at Aurignac places the age of our lake-dwellings at a comparatively late period, although almost immediately under our peat-beds, with their rich treasures, similar antiquities are found: nay, still older remains are met with, only a little deeper, in the slaty, brown coal of Dürnten, perhaps forty feet under the bed of the Lake of Pfäffikon, than those of Aurignac, which have been gnawed by hyenas after having been despoiled of their marrow by human hands."

A very important part of the work before us refers to the settlements on the mainland, which corresponded with the lake-dwellings, and were contemporaneous with them. At Ebersberg, Burg, Uetliberg, and Windisch, settlements have been discovered in which "the stone celts, flint knives, what are called corn-crushers, tools of bone and bronze, as well as implements of bone and bronze, all appear perfectly identical with the antiquities of the lake-dwellings on both sides of the Alps. And in the presence of this fact, the correctness of the conclusion cannot be doubted in the slightest degree, that the settlements of the same people who erected the lake-dwellings were also spread over the mainland."

The manufactures of the lake-dwellers exhibit an advance from rude periods to the time when Roman civilization exerted

some influence upon them. "The whole of the pottery," say our authors, "may be divided into two classes, according to the nature of the material, one, a coarser sort, made of clay mixed with a large quantity of grains of stone; and a finer kind, made of washed loam, in some cases mixed with a small quantity of charcoal powder. The shape of the vessels in the older settlements does not vary to any great extent. Urns with a large bulge and thin sides are rare, very few flat vessels are found in the shape of plates; as a general rule, the form approaches that of a cylinder. With respect to ornamentation, . . . it consists only of bosses or impressions made either with the finger or a little stick. On some specimens, worked with greater care, a commencement of the zigzag ornaments may be seen; and some also are painted with graphite and ruddle. It is very certain that many of the large pots were used for cooking, for they are covered on the outside with soot."

The writers of this work very properly reject the theories which endeavour to mark out the "stone" and "bronze" ages as sharply defined. They see that improvements came gradually in old times as they do in new, and that transitions were gradual as they are now. But as the lake-dwellers learnt to cast bronze, and finally to work iron, they improved their various arts, and the pottery associated with bronze implements bears marks of augmented skill and increasing tact. "Still, at this period no vessels are found artificially formed with long narrow necks, like bottles, flasks, or jugs, which are so abundant in Roman times." The numerous plates with which this volume is illustrated contain a great many sketches of potter's vessels, wrought by hand, not by a wheel, and exhibiting the progress from rude shapes to elegant forms.

A very curious kind of pottery was ornamented with plates of tin, as thin as paper, which seem to have been pressed into the earthenware while it was soft, and contrasted with the black ground of the vessel so decorated. One of the plates gives a picture of a round dish of this sort found at Cortaillod. "The (tin) ornamentation consists of a rosette in the middle, formed of quadrangles, which is surrounded by a band of a pattern similar to that called the meander. . . . . The material is dark grey, blackened by graphite."

In textile fabrics the lake-dwellers, evinced considerable skill, and they arrived at the art of working by means of some kind of loom. As the weaving together of twigs for basket work bears a close resemblance to the weaving of softer materials into cloth or net, we shall commence with the former, and we learn that ropes or basket handles of twisted willow twigs have been discovered. Mats have likewise been found of bark, varying in the complexity

of their manufacture. A simple cross plat under and over making a square pattern is represented in one of the plates. In other patterns (also depicted) "the warp is made of twisted strips of bark, and the woof of flat bands." Other patterns are still more complicated. Many articles made of flax have been discovered, and in some of them the famous "weaver's knot" appears. Fishing nets were made of flax, and many specimens of linen cloth, which, though rude as compared with the productions of civilized races, yet evince considerable skill, and are pronounced by persons in the trade to have been made in some kind of loom.

When specimens of linen cloth of a complicated pattern were first obtained, it was thought that they might have become accidentally associated with earlier fabrics, but investigation convinced the Swiss antiquaries that "these questionable specimens are the actual relics of the lake-dwelling settlers, and belong to the same age as the implements of stone and bone."

The lake-dwellers were acquainted with some mode of dressing and preparing the skins of animals they killed, but the remains of their industry in leather have been very imperfectly preserved, and little more than the fact of its existence seems to have been ascertained.

Our plate in vol. v. gives illustrations of the bronze work of the lake-dwellers, and the volume before us contains an immense number of engravings fully illustrating this very interesting subject. From a chemical analysis made by Professor Fellenberg, of Berne, it appears that the bronze of many of the weapons and implements discovered in the western part of Switzerland, consists of pure tin mixed with copper, containing a little nickel, "while not a trace of this metal is to be found in bronze objects met with elsewhere." Copper of this kind is afforded by the ores of the Valais, and it is conjectured that the lake-dwellers worked these ores, and obtained their tin from the Cornish mines.

No definite line of demarcation separated the "stone age" from the bronze period, but as metal implements became more plentiful the stone ones gradually disappeared. Considerable skill was attained in the manufacture of bronze articles, and in many cases the form and the ornamentation is of a pleasing kind. The lake-dwelling of Nidau-Steinburg, lake of Bienne, has supplied very numerous illustrations of bronze manufacture, including sickles, knives, celts, spear-heads, pins, rings, hooks, etc. Many of the pins were of an ornamental character (see our plate, vol. v.), and it would appear that armlets of the same materials, engraved with elegant angular patterns, were also in vogue.

At Marin a great many objects of iron have been found, swords, lances, rings, brooches, etc., etc. Other localities have likewise afforded iron articles, but Marin has yielded the richest supply. Professor Keller says, "The following facts result from the investigation of the arms and implements of Marin, and their comparison with the specimens found in England, Alesia, and Berne:—The form of the swords and lance points, the ornamentation on the sword sheaths, the marks on the sword blades, the numerous Gallic coins found with them, and the wide-spread district where they occur, show that all the Marin antiquities have come from some of the workshops of Gaul, perhaps situated amongst the Belgæ." In another instructive passage Professor Keller observes that, "in looking over the specimens from Marin what strikes us most is the fact that the weapons, and other implements, differ so essentially, both in material and form, from the products of the older settlements; not only has iron taken the place of bronze, but the form and ornamentation are so different, that one is tempted at first sight to attribute their origin to another nationality and another district. But when we carefully consider this phenomenon it appears less striking. For if we compare the relics of a pure bronze station, such as Wangen or Mooseedorf, that is, of simple bronze implements, with those of stone, wood, and bone, the difference between them in whatever is necessary for sustaining life is found to be much greater. It is certain that these are passages or transitions from the stone to the bronze period. On the one hand, we find a number of stations in which stone or bronze objects are mixed together in different proportions, and which reveal to us the gradual diffusion of metal tools. On the other hand we can follow up the development of the art of bronze casting, and see how at first implements of this material took the form of those of the stone age."

When the Marin objects were made, iron had full possession of the field, and the forms of the object had undergone a change, partly from the peculiarities of the metal, and partly, no doubt, from a considerable alteration in wants and modes of thought.

That people should continue to occupy lake-dwellings after they had acquired possession of iron implements made with great skill, does not appear as surprising to us as it does to some other observers. In our own day the conservative element which resists progress, perpetuates practices and processes long after better ones are known, and we are usually driven to improvements by the force of competition. Amongst a barbarous people the conservative element dominates their entire lives, while a semi-civilized race retains enough of the

same spirit to resist innovations with a steady and powerful force. Besides, the lake-dwellings may have been favourite abodes for a fishing and semi-aquatic population, long after they ceased to be desirable on the score of defence. Possibly a diminution in the quantity of fish easily procurable had more to do with the abandonment of these villages than anything else. When fish abound, and a family can secure a dinner by the simple expedient of suspending a few hooks and strings in the water, the temptation to live close to, or on the water, must be very strong.

Many interesting questions concerning the lake-dwellers remain to be worked out, but enough is known to warrant the belief that in certain stages of human progress—not necessarily coincident in point of actual time—the same mode of living has been adopted by different races in various countries. The crannoge of Ireland bears some resemblance to the pile-dwellings of Switzerland, and our own fen districts will most likely show that we had our population of lake-dwellers, when much of the land, now artificially drained and dried, was permanently submerged.

PROGRESS OF INVENTION.

PHOTOGRAPHY WITH DRY PLATES.—Photographers have never ceased to look for a process by means of which dry instead of wet plates might be used. Many such processes have been proposed; but though some of them have answered tolerably well, the greater length of time required for exposure, and generally a want of delicate graduation, and therefore of truth, in the tints and shadows obtained, has prevented any of them from being generally adopted. A want of complete success is the more unfortunate as the necessity for using a wet plate involves a very large amount of trouble and annoyance; especially when mountainous and other places accessible with difficulty, are to be visited. This inconvenience which has so long been felt, is now overcome; at least so far as perhaps it is possible to overcome it; since a wet must ever be superior to a dry plate in sensitiveness. The improved process, which is due to Mr. W. England, consists in adding to each ounce of ordinary bromo-iodized collodion, two grains of bromide of cadmium and two grains and a-half of common resin, then shaking the bottle well and allowing it to rest for a couple of hours. After this it may be used for coating the plate, which is sensitized by being placed for a few minutes in a silver bath that contains forty grains to the ounce, and four drops of nitric acid to the pint. The development is effected, after running a little varnish round the edges of the plate to prevent the film from becoming loose, and slightly washing, by ordinary iron solu-

tion, to which when it is poured off the plate two or three drops of a thirty-grain solution of silver are to be added, after which it is to be poured on again. Should it be found that the exposure in the camera has been too short, the development may be continued by a gelatino-iron solution. The fixing is effected in the usual way. The resin is supposed to act mechanically; and employed in this manner, the developer need not be pyrogallic acid. Only double the time required for exposure with a wet plate is necessary when this process is employed, and the pictures obtained by means of it are quite satisfactory. It involves, however, one inconvenience: fogging begins to take place after a certain number of plates have passed through the bath. But the addition of a few drops of ammonia or solution of carbonate of soda, and a few drops of solution of cyanide of potassium, placing for a few moments in the sun, filtering, and slightly acidifying with nitric acid, not only renders the bath as good as before, but suits it admirably for use in the wet process.

New Bleaching Process.—Until a comparatively recent period the process of bleaching was extremely tedious; it is still both troublesome and expensive. As it is carrried on to an enormous extent, any improvement in it is a matter of the highest importance. It has been greatly simplified by MM. Tessié du Mothay and Rousseau, without being rendered less effective or less generally applicable. The article to be bleached is immersed in a solution of permanganate of soda, which has been rendered slightly acid, and is stirred about in it for a few minutes with a glass rod. It is then plunged into a solution of sulphurous acid, which removes the violet brown oxide of manganese deposited upon it in the first bath. After the successive immersions in the two fluids have been repeated two or three times, it is found to be beautifully white, without its fibres being in the least impaired in strength. In this, as in all the processes which have been used for bleaching, oxygen is the agent which destroys the colouring matters; but it is here applied in the form of ozone, which is disengaged from the permanganate by the organic matters. Permanganate of soda, is at present, somewhat costly, but MM. Du Mothay and Rousseau have discovered a method of producing it that is extremely economical.

Substitute for Sodium Amalgam, in Metallurgical Operations.—The gold set free in extremely minute particles from crushed quartz, etc., is covered with an inpalpable powder which protects it from the action of the mercury intended for its separation, and thus a considerable amount of gold is lost. In addition to this, the mercury thrown into a state of minute division by the agitation employed, being covered by the same impalpable powder, is incapable of reuniting: a considerable portion therefore assumes the appearance of a fine powder, and is carried off with the refuse; and thus a large amount of mercury is wasted. These two sources of loss have caused a great diminution of profits. It was, however, fortunately ascertained that the brilliancy of the mercury is restored, so that it will run together freely, and unite with the gold with the greatest avidity, if a minute quantity of sodium amalgam

is added to it. Hence sodium amalgam is now an important article of commerce. It is considered highly explosive, and therefore very dangerous: but such is not the case, the explosive property of pure sodium on coming into contact with water is lost almost entirely when it is associated with mercury, so as to form an amalgam. But sodium amalgam is now likely to be superseded by a far less expensive, and it appears not less useful material. Caustic soda has not only been found quite as effective as sodium amalgam, but it is contested that the sodium in the amalgam actually assumes the form of caustic soda before producing its effect. A very simple experiment will show the efficiency of the soda. If a finely pulverized metallic powder is thrown into water, no amount of stirring will cause it to fall to the bottom of the vessel; it is rendered specifically lighter than the fluid by the coating of air which adheres to it. But if a very small quantity of caustic soda or potash is added it will soon descend from the surface to the bottom. It is supposed that the minute particles of mercury also, and of gold, are prevented from coming into contact by a coating of air, which the alkali removes in a way which has not yet been ascertained. This, if the real, is perhaps not the only effect produced by the alkali. The potash of soda must not be allowed to lose its causticity by exposure to the air during transport, etc., or it will be ineffective: it may have become a carbonate, without those who use it being aware of the fact.

New Application of Tuning-forks.—An instrument has recently been constructed at Paris which possesses great power and sweetness. It somewhat resembles a piano, but is far more simple, as the strings are replaced by tuning-forks, one for each note. The sounds are produced by hammers, and are very persistent unless brought to an end by removing the fingers from the keys, and thus allowing the dampers to act.

Dissociation of Gases at High Temperatures.—Some interesting researches on this subject have recently been made by M. L. Cailletet, in developing the discovery of M. Sainte-Claire Deville, that at a high temperature the constituents contained in a mixture of gases will separate. As it is necessary to cool the dissociated elements rapidly, it was necessary to devise an apparatus suited to the purpose. By means of this apparatus some important facts were observed. Thus, that oxygen has no action whatever on hydrogen, carbon, or carbonic oxide, placed within a mass which is at a temperature higher than the melting point of platinum; and the conclusion arrived at was that all bodies would most probably be dissociated by a temperature sufficiently high.

Application of a New Principle to Fire-arms.—The inertia of the projectile causes a certain time to elapse before it is set in motion. A certain amount, therefore, of the force of the gunpowder is wasted, and the more rapid the explosion the greater the loss, from this cause. M. Galant, of Liege, has invented a breech-loader which meets this difficulty. The force of the charge is first communicated to an elastic body which is easily set in motion, and the force which in ordinary cases is wasted, but in this is stored up, is gradually

communicated to the ball, after it has begun to move. The charge is ignited by a needle, the explosion commencing at the end next the ball, but between the latter and the powder, are placed five pads of felt, those next the ball having been for the sake of lubrication, moistened with a fatty matter. This arrangement altogether changes the nature of the explosion. A white smoke escapes from the muzzle, instead of flame, and the penetrative effect is so great that with a charge consisting of 6·5 grammes of powder and a cylindro-spheric steel ball weighing fifteen grammes, a plate of steel twenty-nine millimetres thick was perforated at the distance of one hundred metres. Omitting any of the pads causes a proportionate increase in the recoil.

NOTES AND MEMORANDA.

The Worm Phenacia Pulchella.—We are indebted for the following remarks to Mr. Jonathan Couch, F.L.S.:—"The Intellectual Observer, No. 55, informs us, in a note copied from the *Annals of Natural History*, No. 103, that this has been described as a new species, which it may be to the generality of naturalists, but it is far from new to myself or to Mr. W. Laughrin, A.L.S., who long since sent them to the British Museum, and who has lately dredged a considerable number from sandy ground off the coast of Cornwall, at a depth of about forty fathoms. They appear to be not attached to the bottom, or to any substance at that depth; and that they are even capable of rising high in the water by their own action, appears from a note that I made long since, of one which was obtained, in its case, high in the water over a considerable depth. From the thinness and transparency of the case with the marks of rings, I have supposed that it was formed from an exudation from the surface of its body. This worm readily quits its case, or shrinks into it when afraid."

Spectrum of Apatite.—Mr. W. G. Lettsom writes to us from Monte Video (12th June, 1866): "With reference to the letter of Professor Church, contained in No. 52 of the Intellectual Observer, I beg leave to remark that the apatite which occurs in Spain, I believe at Villa Rica, in nearly colourless transparent crystals, exhibits the absorption bands as distinctly as zircon does. Five of these bands are very clearly defined. One, the second from the red end of the spectrum, is nearly as dark as the black zircon band."

The Rapid Increase of the Star in Corona.—Mr. Lynn, of the Greenwich Observatory, noticing, in *Astr. Nachr.*, a letter from Herr Schmidt, of the Athens Observatory, stating that between half-past eight and half-past nine, Athens time, on the 12th May, he was surveying the heavens near Corona, and must have seen the so-called "new star," if it had been as large as 5 mag., applied, through Mr. Huggins, to Mr. Birmingham, of Tuam, to know at what hour on the same night he saw this remarkable variable as of the 2nd mag. The reply was, not later than 11.45 p.m., local time, whence Mr. Lynn draws the important conclusion, that at 8 p.m., Greenwich time, the star must have been less, and may have been much less, than 5 mag, and that it increased to the 2nd mag. in four hours, either suddenly or with great rapidity. This star was noticed, on the 4th May, by Mr. Barker, of London, Canada West, as brighter than ε Corona. He thinks he saw it one or two years ago.

New Planets.—Mr. Pogson discovered a new planet, 11.5 mag., on the 16th of May. Professor Peters, of Hamilton College, United States, also discovered one on the 20th of June of the same size. The numbers will be (87) and (88). They are named Sylvia and Thisbe.

NEW PARASITIC CRUSTACEAN.—*Annals of Natural History* contains a translation of a paper by M. Hesse on a parasitic crustacean living in a small tumour often noticed in young green wrasses,* not far from the eye and the bronchial aperture. This tumour is formed by the entrance of a young crustacean of the order Lernæida under the fish scales, which it displaces as it grows, and eats a hole in the flesh. The body is fusiform; head small, rounded at the apex, bearing above a median eye, a proboscidiform process with denticulated jaws, and three pairs of prehensile footjaws.

DIALYTIC ACTION OF INDIA RUBBER AND METALS ON GASES.—A paper by Mr. Graham will be found in *Proceedings of the Royal Society*, 86, on this subject, in which it is stated that a thin film of caoutchouc has no porosity, and is really impervious to air or gas; but the same film is capable of liquefying the individual gases of which air is composed, while oxygen and nitrogen, in the liquid form are capable of penetrating the substance of the membrane (as ether and naphtha, etc.), and may again evaporate into a vacuum, and appear as gases. When thus acting on air, oxygen is absorbed two and a-half times more abundantly than nitrogen. The penetration by hydrogen of platinum and iron tubes, discovered by M. M. St. Claire Deville and Troost, is supposed by Mr. Graham to be connected with "a power resident in these and other metals to absorb and liquefy hydrogen, possibly in its character as a metallic vapour." Palladium foil at 100° C. condenses 643 times its volume of hydrogen, but has no absorbent power for oxygen or nitrogen. Mr. Graham observes, "It is believed that metallic pores, and indeed all fine pores, are more accessible to liquids than to gases, and in particular to liquid hydrogen."

CONGELATION AND DEATH OF ANIMALS.—Dr. Davy, finding that a statement made by him many years ago, to the effect that a leech might be frozen without loss of life, was contradicted by more recent experiments of M. Puget, has repeated his investigations on leeches, frogs, etc., and he arrives at the conclusion that "the thorough congelation of an animal is incompatible with life." It is still, however, not certain to what extent congelation may be carried without death necessarily ensuing. What, for example, are we to make of the story of the frozen carp told by Sir J. Franklin, and cited by Mr. Couch. The amount of freezing in these cases may have been *nearly* complete. Dr. Davy's paper is in *Proceedings of the Royal Society*, 86.

MAGNETIC ACTION OF THE MOON.—*Proceedings of the Royal Society*, 86, contains a paper by Lieut.-General Sabine, F.R.S., on the lunar diurnal variation of the magnetic declination, and of the horizontal vertical components of the magnetic force, derived from seven years Kew observations, and from comparison with observations in other parts of the world. The paper states that "a magnetic variation shown to be thus obviously dependent upon the moon's position relatively to the terrestrial meridian, and agreeing in its principal features in such various localities, is urged by the author as being ascribable, with great probability, to the direct magnetic action of the moon."

CRYSTALLIZING CARBON.—M. Lionnet gives the following process in *Comptes Rendus*:—Take a long thin leaf of gold, or better of platina, and wind round it a helix formed of a similar tin leaf, so that the covered and uncovered portions of the platina shall be about equal. With the metallic couple thus formed a spiral is made, and plunged into sulphide of carbon. The sulphide is slowly decomposed, the sulphur combining with the tin, and the carbon being precipitated in crystals.

* For an account of the wrasses, see Couch's *Fishes of the British Islands*.